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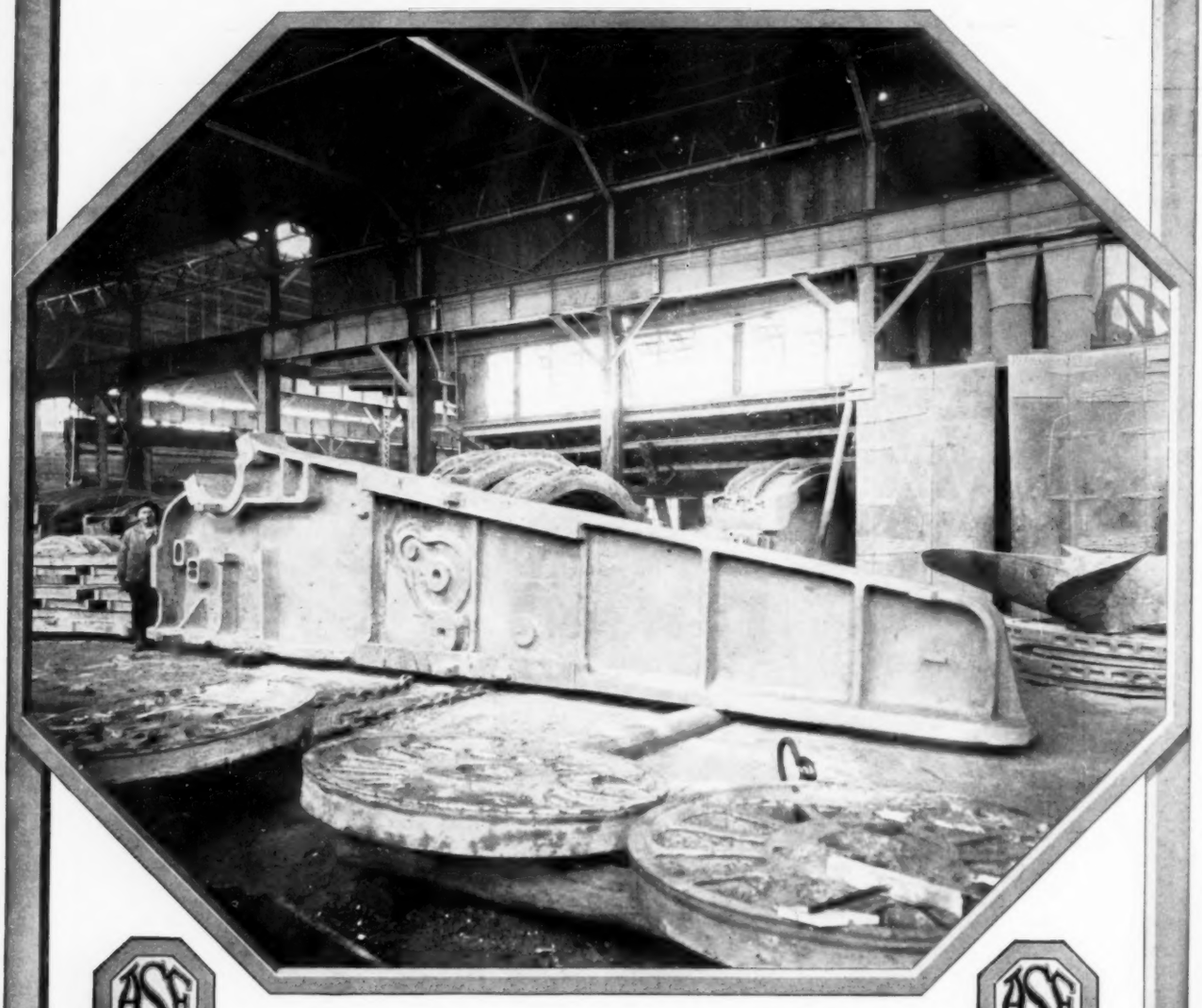

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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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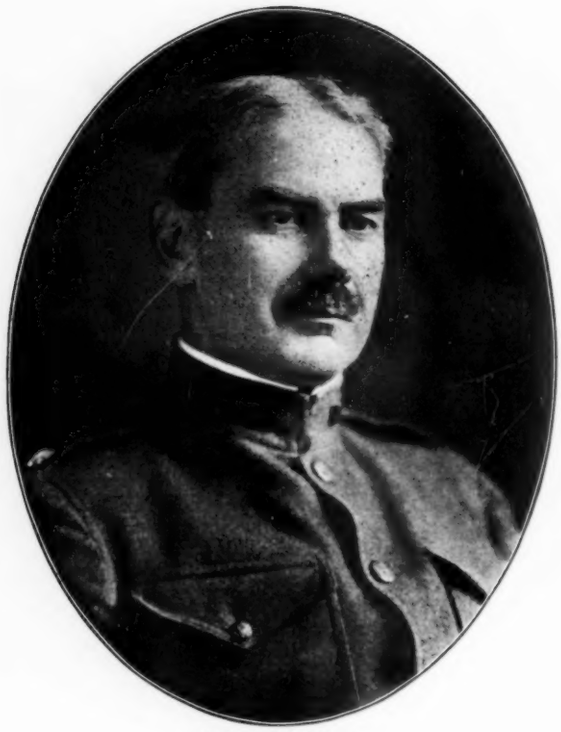
Rock Island Arsenal 1862-1925



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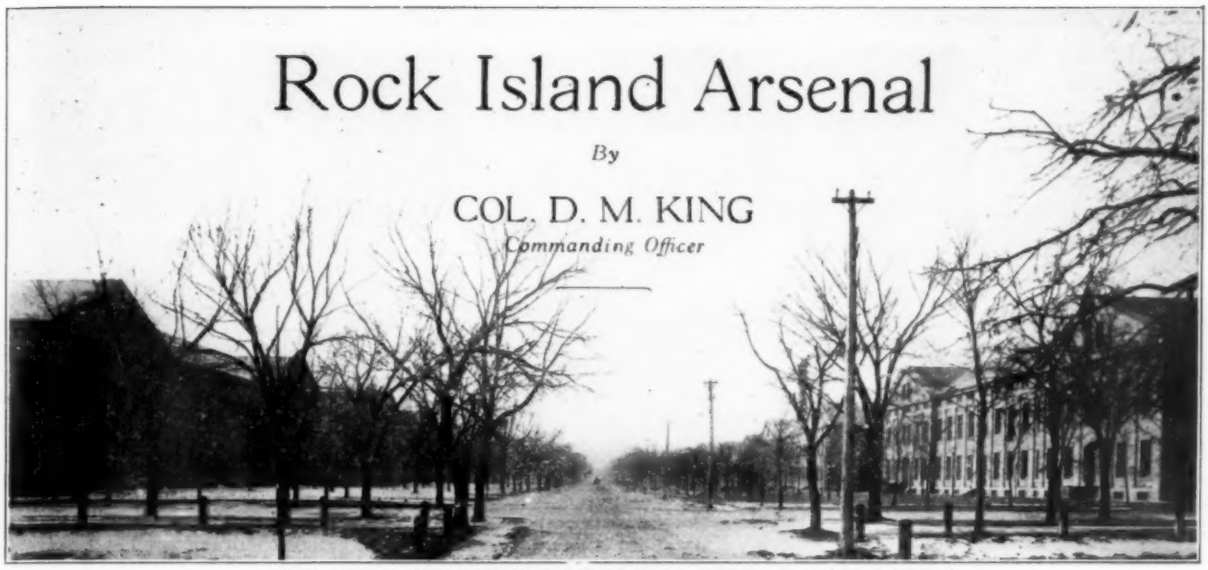
Rock Island Arsenal

By

COL. D. M. KING

Commanding Officer



Main Avenue, Showing North and South Rows of Shops, Rock Island Arsenal

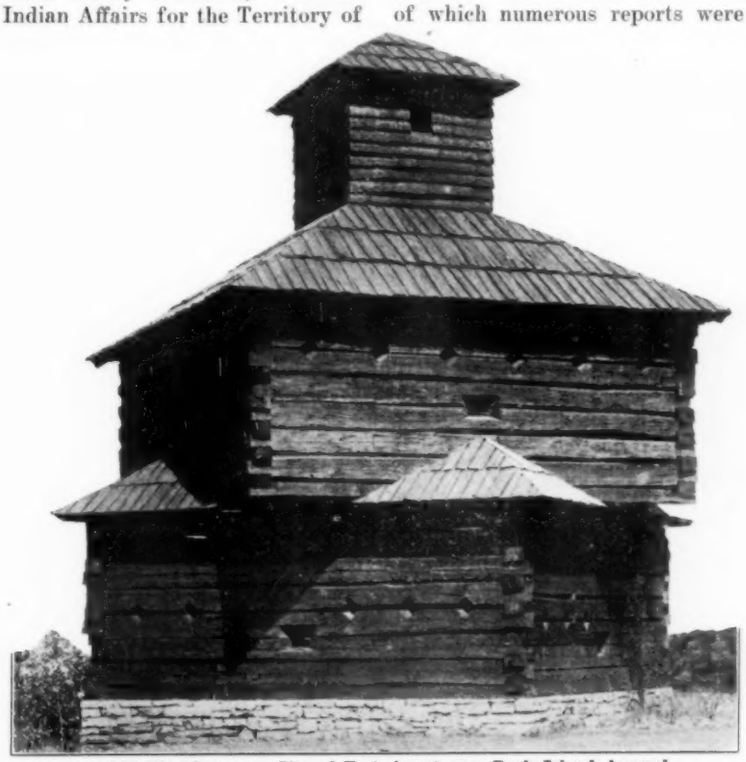
IT is the function of the Ordnance Department to design, procure, produce, inspect, maintain and distribute such matériel as shall be prescribed by the General Staff. Arsenals are maintained to assist the Department in the many duties with which it is charged, and, of those now in operation, Rock Island Arsenal is the largest.

It embraces the entire island of Rock Island, comprising approximately 900 acres, and is situated well to the south of the main channel of the Mississippi River between the adjoining cities of Moline and Rock Island on the Illinois side of the river and Davenport on the Iowa side.

The title to the island was acquired through a treaty with the chiefs of the Sac and Fox tribes of Indians, made by General William Henry Harrison, Governor and Superintendent of Indian Affairs for the Territory of Indiana and District of Louisiana in November, 1804, but the reservation for military purposes derives its validity from the Act of June 14, 1809. The hostile advances of the Indian tribes from the north, following the outbreak of the War of 1812, upon the settlements of the pioneers in the Illinois Territory led the government to establish, in 1816, a frontier post on the extreme northwestern point of the reservation, which was named Fort Armstrong in honor of the then Secretary of War. This post, garrisoned by two companies of Infantry, was maintained for a period of approximately twenty years, during which time its presence exercised a restraining influence upon the predatory Indian bands of the surrounding territory.

The troops were withdrawn from the post upon culmination of the Black Hawk War and its affairs placed in the hands of an Indian Agent. Following the abandonment of the fort by the military authorities, squatters, attracted by the advantages which its superior location afforded, settled upon a considerable portion of the Island's area with a view to its preemption under the regulations applying to all public lands not set aside for a particular purpose.

In 1835, Congress directed that an examination be made of various sites for a western armory, as a result of which numerous reports were made by army officers recommending the selection of Rock Island for this purpose and citing its many natural advantages, among these being its location in the Mississippi Rapids, where, owing to a fall of several feet with the immense volume of water, a great water power was available; its security from attack by the enemy in time of war; its convenient and favorable situation with respect to markets for necessary supplies and the facility with which material might be received and shipped.



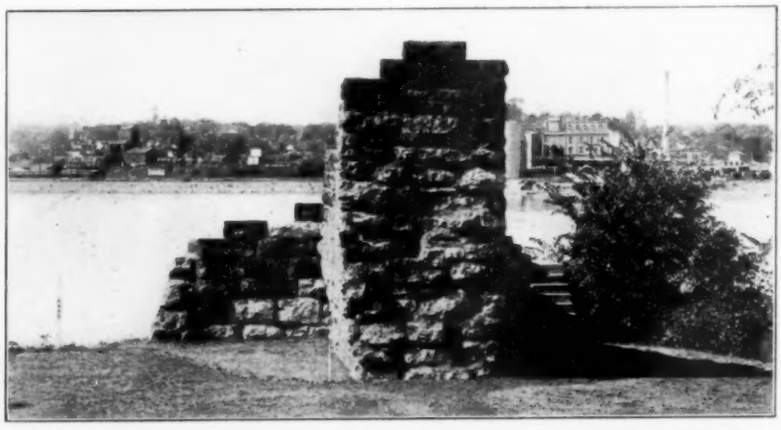
Old Blockhouse on Site of Fort Armstrong, Rock Island Arsenal

Such was the status of events which led to the authorization by Congress on July 11, 1862, of the establishment of Rock Island Arsenal, of which the present plant is the outgrowth. At that time, it was the intention, with the amount appropriated, viz., $100,000, to construct merely a small arsenal for storage and repair rather than one for general manufacturing purposes.

Entrance to Confederate Cemetery, Rock Island Arsenal

Colonel C. P. Kingsbury was appointed its first Commanding Officer, and, one year later, under his supervision, the construction of the storehouse, which still stands at the western point of the island, was begun. During his administration, practically nothing was accomplished toward its completion. A military prison, built during the Civil War, in which over twelve thousand Confederate soldiers were confined at various times, occupied a considerable portion of the island's central area. Not only did the presence of this prison retard Colonel Kingsbury in carrying out his construction plans, but his progress was further hampered, due to the fact that before the land could be acquired it was necessary to invoke legislative action to extinguish title to various claims which had been held by certain settlers since the abadonment of Fort Armstrong. This action Congress did not take until April 19, 1864.

In 1865, Colonel Kingsbury was relieved and General T. J. Rodman assigned to command. Under the latter's administration, definite plans were formulated for a permanent arsenal for manufacturing purposes. He conceived and developed the idea of the ten great shops as they stand today, comprising the Arsenal and the Armory Row. These shops are all alike in plan, each having a frontage of 210 feet, with wings 300 feet deep and 60 feet wide; the courtyards measure 238 feet in depth and 90 feet in breadth; all but two of the buildings are four stories high (including basement and attic). The total floor area of each of the eight structures is about 44,000 square feet, slightly more than an acre per floor, and each has a combined area of four acres per building. The central structure in each row of shops is but one story; that in the Armory Row on the north side of the Avenue having been designed to serve as a forge shop, while the corresponding building in the Arsenal Row on the south side serves as a foundry.



Old Pier of the First Bridge Across the Mississippi River, Rock Island Arsenal

Captain D. W. Flagler, General Rodman's successor, carried to conclusion the construction plans the latter had formulated, and, in addition, made many other improvements. Under his administration, eight of the ten shops were completed, together with officers' quarters, barracks and storehouses. Under his supervision, the system of sewers was laid out and streets, roads and sidewalks constructed. The Arsenal's later expansion has left undisturbed, as monuments to the ability of these two able Ordnance officers, the two rows of shops which they designed and constructed.

Captain Flagler was followed by other efficient officers of the Ordnance Department, all of whom, during the period of their commands, assisted in the development of the Arsenal and brought it to that stage of its advancement which permitted its ready expansion to meet the emergency created by the Spanish War. During this period of activity, the Arsenal was under the command of Captain S. E. Blunt. When he assumed command in 1897, its construction period had passed. Further development of its facilities was not deemed necessary, as those already provided proved ample for the limited manufactures, which, at that time, constituted the output of the shops. Prior to his administration, the total expenditures for the establishment had been nearly nine million dollars. Of this amount, three-quarters of a million had been spent for the substantial bridges connecting the island with the neighboring cities of Davenport, Iowa, and Rock Island and Moline, Illinois (all of which structures are under the control of, and are maintained by, the Ordnance Department), one and one-half million had been spent to erect its buildings and prepare the grounds, and the remainder, less than a quarter of a million, covered expenditures made for machinery and appliances for equipping the shops. Due to the fact that the operation of the Arsenal had, up to this time, been sufficient to meet the ordinary demands of a small army on a peace footing, Congress had not seen fit to make more liberal allotments to provide increased shop facilities. Its manufactures up to this period were limited to gun car-

Site of Old Fort Armstrong, Looking Down the Mississippi River, Rock Island Arsenal

riages, with their pertaining equipment, which activities comprised the output of a single department, while in several others the miscellaneous articles of infantry, cavalry and horse equipments were fabricated. The combined manufacturing operations occupied but three floors in one of the shops and a small portion of the area of several others, or, in all, approximately 14% of the total floor space which the ten shops provided. Less than five hundred men were employed, with a monthly payroll amounting to $30,000.

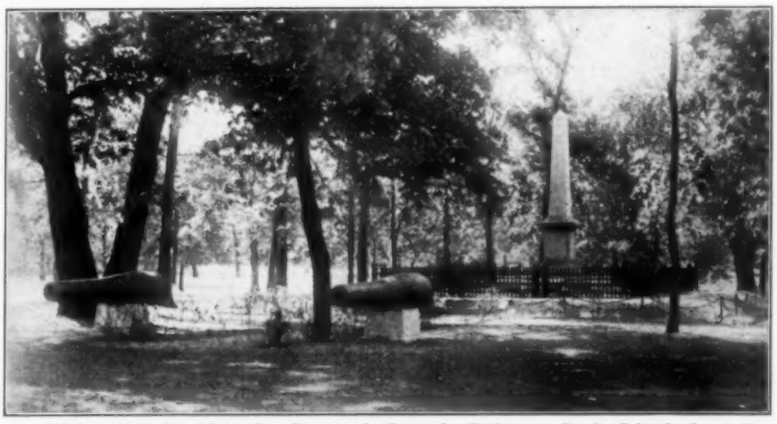
Then came the sudden demands as a result of the emergency incident to the Spanish-American War. The burden of supplying the bulk of the Army's requirements for munitions naturally fell on Rock Island Arsenal. Its plant facilities were not entirely adequate. However, after certain re-arrangement of machinery in the different shops had been made with a view to adapting them to the changed conditions resulting from the rapid expansion of its operating forces, production was soon gotten under way and the largely increased demands of the army in the field satisfied. To augment the output of the shops, extensive calls were made by the Arsenal upon contractors for supplying infantry and cavalry equipment, the money value of which approximated one and one-quarter million dollars. Under the stress then existing, the employees increased in number to 3,000, with a monthly payroll of $175,000.

When this emergency had passed, a complete re-arrangement of all machinery, which experience, as a result of the war, had shown to be advisable, began. As an illustration of the extent of the scope of this re-arrangement, it may be stated that, at the outbreak of the war, the tin shops had been equipped with but one power press and a complement of minor machine tools and appliances, capable of poducing, at its maximum output, but 300 tin cups and 125 meat cans per day of eight hours, with no facilities for manufacturing canteens. As a result of the development, it attained an output on the three items of the mess outfit alone of 300 tin cups, 6,000 meat cans and 4,000 canteens per eight-hour day, together with a corresponding increase in numerous other minor articles. Similarly, other departments were enlarged and expanded with equally gratifying results.

Interest in the East quite naturally centered more especially on the Springfield Armory, Springfield, Mass., and the Watervliet Arsenal, Watervliet, N. Y. Until the establishment of the small arms plant in the West, the former was the nation's only source of rifle supply. The press had, apparently, never exploited the work of the western arsenal, and the general public knew very little of its activities, although it had for years been supplying the Regular Army and the Militia with such equipment as haversacks, canteens, saddles and bridles, and building siege and field gun carriages and producing other essential matériel for maintenance of the Army and generally carrying out the purpose for which it was maintained. The war with Spain, however, marked for Rock Island the dawn of a new era. The Arsenal's achievement as a result of this crisis brought it the recognition publicly which it had gained officially, that of being the country's largest and most important manufacturing plant and the principal depot for issue of supplies to the Army.

The original plans of the Arsenal contemplated the use of the northern row of shops for the manufacture of small arms. The Arsenal's activities prior to and through the period of the Spanish-American War had been confined solely to the southern, or Arsenal, row. For many years, the National Armory at Springfield, Mass., with its output of small arms, was capable of meeting the moderate demands of the National Guard and the small Regular Army, at least to the extent of the limited funds which Congress annually appropriated. For this reason, no steps had been taken toward securing an appropriation for the establishment of a small arms plant in the West. The heavy demands which were the result of the war with Spain made it advisable to supplement the plant at Springfield Armory with a similar one at Rock Island Arsenal.

The water power of the Rock Island Rapids was one of the factors which determined the selection of its present site for the location in the Mississippi Valley of a large arsenal. The value of that power was one of the principal arguments which induced Congress to appropriate funds in 1899 for an auxiliary small arms plant in the West. The plant installed and placed in operation several years later was capable of producing a maximum of 125 rifles per day, and, while it never became



Monument Marking the Grave of General Rodman, Rock Island Arsenal

necessary until the World War to attain the plant's maximum capacity, large quantities of rifles were produced for many years following its installation until the accumulation of surplus arms lead to the suspension of manufacture of rifles at this Arsenal.

Artillery Vehicle Plant, one of the Largest of the New Buildings at Rock Island

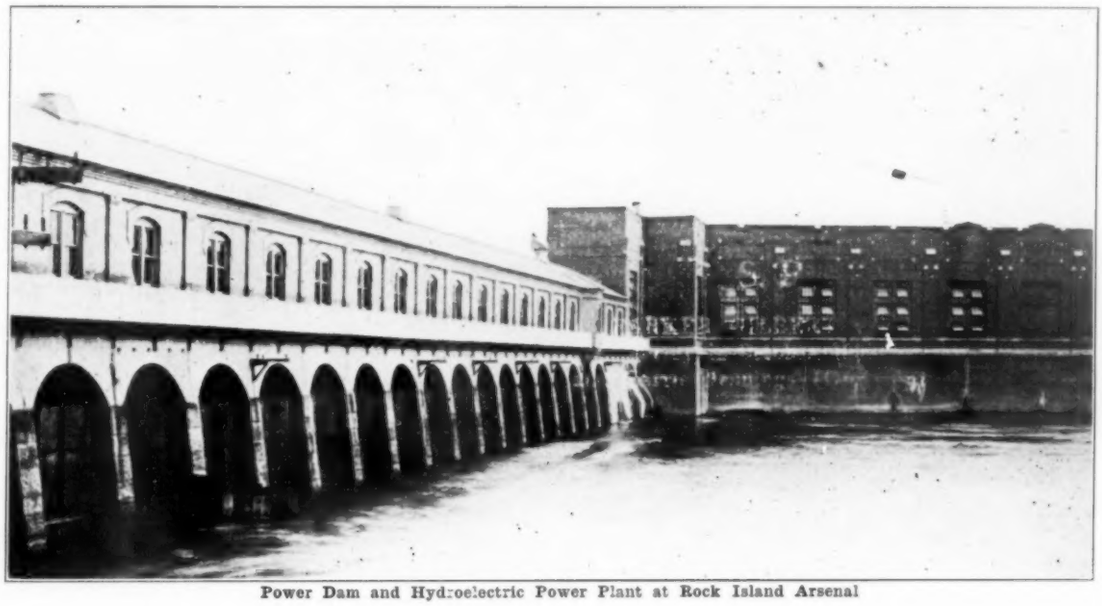
Parallel with the steady growth of the Arsenal has been the development of its water power. The Rock Island Rapids between the lower extremity of the island and a point opposite the northern limits of the City of Moline, Illinois, has a fall of about seven and one-half feet. While but moderate, this fall gives, with the great volume of water, sufficient power, if properly developed, to meet the needs of the commercial industries of this entire community. At the time the government constructed the water power dam, forty-one openings for water wheels were provided. Up to the outbreak of the Spanish-American War, but eight turbines had been placed therein, leaving the remainder for further development. The type of turbine which had been installed produced but 35 h. p. per wheel, a total of 280 h. p. for the entire plant. This sufficed for the limited operations up to the time of the war with Spain, but had, of course, to be supplemented by steam power during the latter emergency at a considerable increase in cost of plant operation. The appropriation for the establishment of the small arms plant afforded the means whereby the additional power could be provided. The eight turbines of obsolete type were discarded and fourteen others of approved design installed, giving a total of 2,100 h. p., which provided a liberal surplus over the actual requirements for machine operations in both Arsenal and Armory Row.

In the foregoing account of the arsenal's history, two periods of its development are evident, the first, the period of construction, during which the great quadrangle of shops, with the outlying storehouses, barracks, quarters, power house, etc., was built, extending from its establishment down to approximately the outbreak of the war with Spain; the second, that of the expansion of its facilities immediately following the latter period, during which a well-considered plan for its future development was adopted and resulted in seven of the shops being fully equipped and placed in operation. The extent to which the facilities of the plant were being utilized prior to the World War may be gathered from the statement that for the ten years prior to that time the monthly payroll for labor exceeded $100,000, while the monthly outlay for purchase of raw material entering into the Arsenal's fabrications aggregated the same figure.

Main General Storehouse at Rock Island Arsenal

At the time of the Midwest Preparedness Conference in Davenport, Iowa, in the fall of 1915, the prediction was made that Rock Island Arsenal was destined to become the "Essen of the United States." The activities which resulted following the entrance of the United States into the World War fulfilled this prediction. The year 1916 marked the beginning of a new epoch in the history of the Arsenal and the several years which followed gave it the crucial test of its career. From the day the United States entered the war until the day the Armistice was signed the government authorized the expenditure at this Arsenal of $108,055,974.07. Of this amount $89,343,840.59 was disbursed, the balance having been revoked as a result of a change of policy following notification of availability of funds. The magnitude of the expansion of its facilities will be realized from the statement that in the three years prior to the entrance of the United States into the war its average yearly allotment of funds approximated $9,000,000. Of the $89,343,840.59 credited to the Arsenal, $66,526,540.31 was utilized in the fabrication of ordnance and the purchase of raw material which entered therein. This amount also included the item of labor. For increased facilities, new machinery, alterations and new buildings (the latter for manufacturing purposes solely) $17,341,487.69 was expended; while the sum of $3,915,812.59 was spent for storage, temporary barracks, guard-houses and other incidental structures. Interesting comparisons between the total and average monthly disbursements for the three years prior to the war and for the period covering the Arsenal's participation in the war may be drawn. During the period from August, 1914, when the European nations began fighting, until April, 1917, when this country declared itself in the struggle, the total expenditure at Rock Island Arsenal was $11,759,935.90, of which purchases constituted $7,-

115,849.53 and labor $4,644,086.37. The monthly expenditure during this period avreaged $222,370.29 for purchases and for labor $145,127.69, with a monthly average for the thirty-two months preceding the date the United States declared war of $367,497.98. In striking contrast to these amounts are those amounts for the actual time this country was at war; for purchases and labor the total amount disbursed was $59,587,390.18, of which $42,466,-



Power Dam and Hydroelectric Power Plant at Rock Island Arsenal

874.67 represented purchases and $17,120,515.51 labor, making the total average monthly expenditure $3,077,-861.05. These figures, it will be understood, cover those incident to the Arsenal's activities exclusively and do not include the vast sums which were disbursed for both labor and matériel by cost plus and lump sum contractors engaged on construction projects at the Arsenal during the war.

The rapid expansion of the organization constituting the productive unit, permitting operations to be carried on so extensively as the above figures manifest, was one of the Arsenal's chief problems. In 1914 the Arsenal's force numbered about 1,800 men and 175 women, the latter being confined solely to clerical operations. This number remained more or less constant until 1916, when as a result of the disturbance on the Mexican Border, a slight increase in activities became apparent, following which additions to the extent of several hundred employees were made. From this time on the force was gradually increased at the rate of two hundred per month so that the number on the rolls at the time war was declared totalled about 4,000, of which number approximately 300 were women. At the close of the calendar year 1917 the force had increased to 6,500; in May of the year following, when the first women shop workers were engaged, to 9,400; at the signing of the Armistice its workers numbered nearly 14,000 and of this number about 1,900 were women.

Colonel George W. Burr was in command when hostilities began and continued in this capacity until the early part of 1918, when the command temporarily succeeded to Colonel N. F. Ramsey, who, in March of the same year, was succeeded by Colonel L. T. Hillman. Colonel Hillman served throughout the remaining period of the war.

Of the vast quantities of articles produced during this period, the principal items included: artillery vehicles, recoil cylinders, wheels, artillery harness, arm repair chests, rifles and miscellaneous personal equipment items; of the major items 159 75-mm. gun carriages, 194 4.7-inch gun carriages, 121 gun caissons, 446 gun and forge limbers and 255 battery and store wagons, were fabricated. Of the smaller personal equipment items 1,512,190 bacon cans, 354,770 knives, 649,457 canteens and cups, 858,344 haversacks and 400,256 pack carriers were produced, the equivalent in the smaller items of approximately 790,000 complete sets.

In addition to the above, the Arsenal supplied numerous test tools and furnished vast quantities of components entering into the complete unit, the remaining parts of which were manufactured and assembled under government contracts at various points throughout the country. Up to August 1, 1918, all the artillery harness supplied to the United States forces was manufactured at this plant. Between April 6, 1917, and November 11, 1918, 24,212 sets of artillery harness alone were fabricated and, in addition thereto, 74,207 sets were assembled. The Cloth and Leather Department during this period was the largest and most completely equipped in the world. In the Small Arms Plant, where alone as many as 3,500 men and women were employed, production proceeded at maximum speed. This department manufactured and assembled, or furnished as repair parts, an equivalent of approximately 113,670 rifles, Model 1903. In the Ammunition Assembling Plant, a structure specially designed and erected at the outbreak of the war for the loading of steel shell, 167,195 155-mm. howitzer shells, without adapters and boosters, were loaded. In many of the major items the maximum production had hardly been reached at the time of the signing of the Armistice. In the output of the 75-mm. carriage, for instance, the production of which for the first two months following March, 1918, when fabrication began, averaged but two, this number was increased in May to sixteen; in June, twenty; in July, twenty-two; in August, twenty-three; in September, twenty-eight, and in October, forty-six. In the production of the 4.7-inch gun car-

riage the maximum was reached in September, when the output for that month totalled fifty-eight, slightly less than one-third of the entire quantity manufactured during the period from January, 1918, when production began, until cessation of hostilities. The high figure in the manufacture of the rifle was reached in October when parts sufficient to make an equivalent of 30,455 complete units were made.

Under the expenditure covering increased facilities which, during the World War, as stated heretofore, totalled $17,341,487.69, the more important structures erected included an Artillery Vehicle Plant (Shop M) and an Ammunition Loading Plant (Shop L). As these two shops created a need for additional power, provision for increased electrical energy had to be made and as the funds appropriated for the former projects included the latter, a new concrete dam was also constructed in the rear of, and at an angle to, the dam then existing, and a hydro-electric plant built, wherein two large generator units, connected direct to water turbines, and two exciter units of modern type were installed. This plant is capable of developing 5,000 h.p., with a 12-foot head of water (which head is available 9 or 10 months per year).

Another utility added at this time was that of the Central Heating Plant, which, with its eight boilers of 500 h. p. each, arranged in batteries of two units, provides a total of 4,000 h.p.

The expenditure of $3,915,812.59 under storage and other incidental buildings included the erection of a large general storehouse (Storehouse W-1) for miscellaneous spare parts for artillery and small arms and numerous vehicle storehouses, as well as others for storing nitrate, all of which increased the available storage space a million and a half square feet.

The process of expanding the nucleus of a peace-time organization of an Arsenal when war is imminent to that of a large well-organized productive unit is no less complex in its nature than that of the demobilization of this force upon cessation of hostilities and its assimilation to peace-time conditions.

Heavy shipments of ordnance to this post from abandoned camps and of components in various stages of completion from private plants upon termination of war contracts arrived in such large quantities following the war that the Arsenal's storage facilities, although largely increased, were still inadequate and in consequence considerable quantities had to be stored in the open. The assembling of stores of a like nature in permanent covered storage; the salvage and sale of the remainder for which there was no probable need; the razing of the many unsightly temporary wooden structures housing war-time activities and the restoration of the grounds adjacent to many of the buildings, which were left in an untidy condition by contractors, constituted one of the Arsenal's principal post war activities.

The vast quantities of ordnance stores produced by all government arsenals and those produced by private industries throughout the country during the war naturally left a large surplus of such material on hand, a quantity sufficient for the needs of the army, at its reduced strength, for some time. For this reason orders for manufacture have not been given any of the arsenals justifying their manufacturing operations being carried on at the rate they normally would be if such a condition did not exist, and to this fact is due the peace time schedule under which this Arsenal at present is operating, which is the lowest of any in its history since the Spanish-American War. Practically no productive work is now being carried on, its operations being confined principally to work of an experimental nature in connection with the design of artillery matériel and repair of equipment turned in from the field. The percentage of capacity at which its facilities are now being utilized may be stated as approximately five to ten percent. This curtailment has reduced some departments, the former forces of which numbered hundreds, to but several workmen. In the Small Arms Plant at the present time but sixteen are employed, while in the Cloth and Leather Department, where only such work in cloth and leather is conducted as pertains to experimental mobile artillery material, but six men are employed. The manufacture of the cloth and leather accoutrement comprising the personal equipment of the soldier has been brought under the supervision of the Quartermaster's Department since the World War.

The Arsenal, as it stands today, represents a valuation at a very conservative figure, including stores on hand for issue and for manufacturing purposes, of $390,708,756.

Its existing facilities permit the production on a large scale of mobile artillery matériel (by "matériel" is meant the complete equipment for carriage, caissons, limbers, battery and store wagons); rifles, mess equipments, arm racks, cartridge storage cases, wooden and paper targets; chests of various types and bayonet, bolo and sabre scabbards. It is also capable, consistent with the processes and equipment now obtaining, of producing many articles of commercial usage which various government departments now require.

Linking the Arsenal with the neighboring cities of Davenport, Iowa, and Rock Island and Moline, Illinois, are the three bridges, maintained and controlled by the Ordnance Department, which are a necessary adjunct of the Arsenal facilities. Of these, the one from Davenport, Iowa, is the largest, being the most substantial structure on the Mississippi north of St. Louis. It has been identified with the Arsenal since its inception and its growth and development forms an integral part of the history of the latter institution. Up to the time when the C. R. I. & P. R. R. Company completed its bridge from Rock Island to the Davenport shore, in 1856, the channel of the Mississippi never had been spanned. The remains of the south pier of the first bridge to cross the stream may yet be seen on the island shore a quarter of a mile above the present structure.

While serving the country in the main in a utilitarian sense, the island, with its many miles of improved roads, constitutes a large park, accessible to the residents of the surrounding community.

The Arsenal's past achievements stand as a pronouncement of the recognition of its ability to serve the country efficiently in any future emergency along the line of its endeavors.

The following is a list of the Commanding Officers of the Rock Island Arsenal, with the dates of their assignment as such:

Major C. P. Kingsbury	July 27, 1863;
Major T. J. Rodman	June 14, 1865;
Captain D. W. Flagler	June 15, 1871;
Colonel T. G. Baylor	May 12, 1886;
Colonel J. M. Whittemore	November 8, 1889;
Colonel A. R. Buffington	January 1, 1892;
Captain S. E. Blunt	March 3, 1897;
Lt. Col. F. E. Hobbs	August 1, 1907;
Lt. Col. George W. Burr	June 25, 1911;
Colonel L. T. Hillman	March 4, 1918;
Colonel Harry B. Jordan	January 20, 1919;
Colonel David M. King	June 3, 1921.

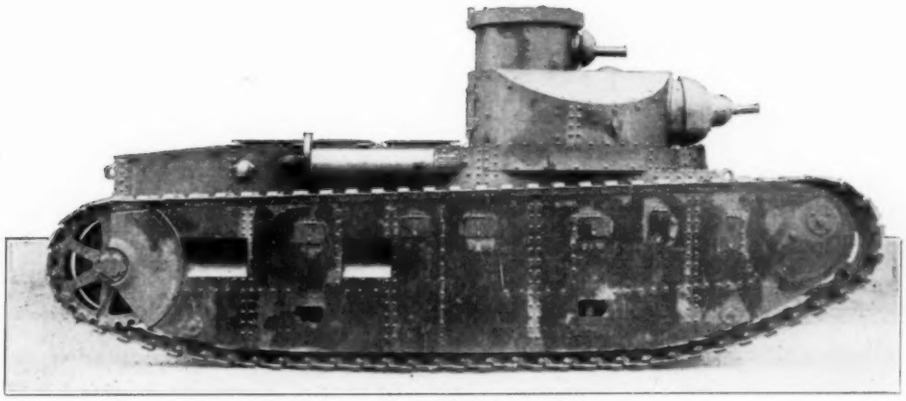


Fig. 1. The Medium "A" Tank

The Design Section at Rock Island

By

LEVIN H. CAMPBELL, JR.

THE Design Section of the Rock Island Arsenal was organized under the Commanding Officer in 1922 to carry on the design of mobile gun carriages, tanks, tractors, motor gun carriages, trailers, and special automotive equipment. The reduction in funds available at that time for pay of engineers and draftsmen in the Ordnance Office in Washington so curtailed the force that it at once became necessary to transfer a large part of design activities, covering the matériel mentioned above, to the Arsenal. This division, as will be seen later, in no way reduces or lessens the responsibility of the Ordnance Office in the initiation or approval of design. No work is undertaken at the Arsenal without the expressed instructions of that office. These instructions, as issued, are accompanied by study drawings or specifications, or by both.

Shortly after the organization, a total of 42 engineers and draftsmen were occupied in the work of the section, but due to decreased appropriations, the force has been reduced to its present strength of 18 men. The organization consists of the officer in charge; the mobile gun carriage design unit, under the immediate direction of a civilian Ordnance engineer, assisted by one computer and four draftsmen; and the automotive design unit, under immediate direction of a civilian automotive engineer, with eleven engineers and draftsmen as assistants.

The mobile gun carriage unit is charged, in general, with the design, or the completion of design from studies submitted by the Ordnance Office, of all mobile gun carriages, from the 37-mm. infantry accompanying gun to the 8-inch Army howitzer carriage. Within this range may be mentioned the 75-mm. pack howitzer carriage, the 75-mm. gun carriage, the 105-mm. howitzer carriage, the 4.7-inch gun carriage, antiaircraft gun carriages, etc. The automotive unit handles the design, under the same general procedure, of tractors, tanks, motor gun carriages, trailers, and special vehicles which are not procurable from commercial sources. It may be stated in this connection, that it is the policy of the Ordnance Department to use commercial automotive vehicles and other articles of equipment whenever such will satisfactorily fulfill the requirements of the using Services. Obviously there is no commercial use for tanks, trailers, for antiaircraft gun carriages, power carts for the Infantry, and motor gun carriages. It is, therefore, necessary that the Ordnance Department carry on its own line of development work, so that the Army may be assured of satisfactory vehicles of this class in time of need. The commercial manufacturer continually carries on experimental and development work, in order that his product may be kept the equal of his competitors; it is equally necessary for our Army to do the same if we wish to avoid again falling into the state of unpreparedness in which all our wars have found us.

Evolution of an Ordnance Design

It is of interest at this point to trace, in general, the evolution of an Ordnance design. The using Service indicates the need of a particular piece of Ordnance ma-

Fig. 2. Testing Flexible Track on Light Truck

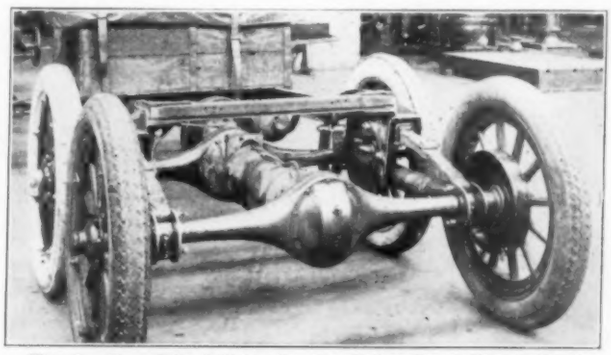


Fig. 3. Four Wheel Drive for the Dodge Light Repair Truck

tériel and outlines the general performance requirements and characteristics. The Technical Staff of the Ordnance Office requests the Manufacturing Service to prepare studies under general specifications, which, when completed, are presented for approval. Having arrived at the definite characteristics of the matériel, detailed specifications are prepared and approved by the Technical Staff. It is especially pertinent to note here that each branch of the combatant arms of the Service has a representative on the Technical Staff. By this means the Ordnance Department avails itself of the experience of the Line officers, and the Line branches are assured that the matériel, in so far as consistent with correct design, will meet their wishes.

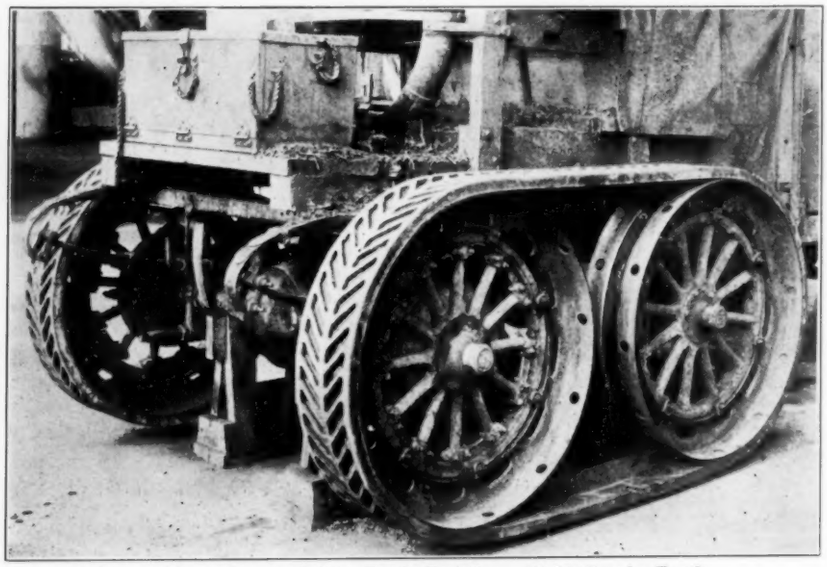


Fig. 4. Rubber-covered Fabric Track Tested on Light Repair Truck

The Manufacturing Service then proceeds to prepare the design, either in the Ordnance Office or at the Arsenal. Upon completion of the major units of the assembly, the drawings are submitted to the Technical Staff for approval. The design is then completed, and manufacture of the pilot vehicle is undertaken. It has been found in many cases to be of great advantage to first construct wooden models of the complete matériel, or certain units thereof, for submission to the Ordnance Office in connection with the drawings. Frequently during manufacture of the model, changes are made to correct errors in drawings, to facilitate future manufacture and to provide better arrangement of parts. It is believed that in every case the wooden models more than pay for themselves, in their use at the Arsenal and in the Ordnance Office. In the design of mobile carriages, models are almost invariably made. In automotive design they are frequently made use of in the case of various experimental units of a vehicle, such as track shoes, suspensions, etc. Before manufacture, the shop men are requested to go over the detailed drawings with the designers and to recommend all changes which will simplify the work in the shops. Many valuable suggestions invariably result from such conferences. During manufacture and assembly, the leading designer keeps in close touch with the job in the shops, approves any changes found necessary, and lends assistance when called upon. The effect is to promote the closest cooperation between the shops and the design section, with resultant harmony and efficiency of the whole.

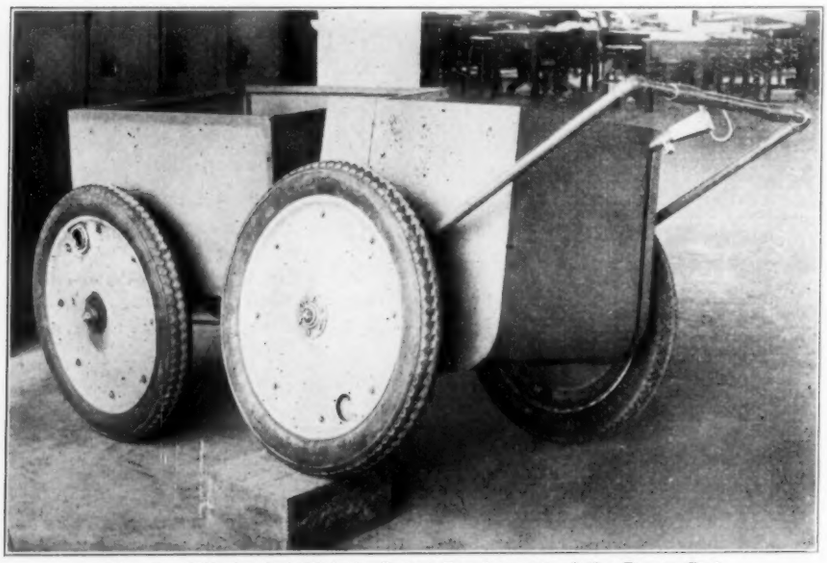


Fig. 5. "Mechanical Mule"—Latest Development of the Power Cart

Development and Research

In addition to the purely design work as briefly outlined above, the section is frequently assigned development and research problems covering a wide range of subjects. Among these may be mentioned the development of metallic packing for recuperator mechanisms. The standard packing now used in recuperators often has a very bad effect on the highly polished cylinders, resulting in discoloration and pitting of the metal. This necessitates frequent overhaul to prevent serious damage, a very costly operation where large numbers are involved. Being of a special composition, with small demand in time of peace, the packing is very difficult to obtain for replacement issue. It is with a view to discarding the rubber packing that the development of the new type was undertaken. To date the results obtained have been very gratifying, and it appears that a satisfactory metallic packing for recuperators will be evolved. The importance of this particular program can hardly be overstressed in its value to the Service, both in money saved, and in the assurance of a usable recuperator even after long periods of storage.

Considerable time and effort were recently spent upon deducing a formula covering the action of Belleville

springs. In checking the formula, a long series of tests of springs of various dimensions and characteristics was conducted by the testing laboratory personnel of the Arsenal. The laboratory of the Massachusetts Institute of Technology also assisted in a series of experiments, employing special equipment which is not available at the Arsenal.

A program of research is now being carried on to determine the effect of skin friction of oil upon counter-recoil buffers, with a view to using the data obtained in future design. This work involves the closest contact between the design section and the engineer in charge of recuperator maintenance for the Arsenal.

In the automotive field may be mentioned as examples of development work being conducted, development of a light fabric track for application to cross-country infantry and artillery vehicles; development and design of a satisfactory pintle and lunette for use with motorized equipment, and the development of a track and suspension for vehicles of the power cart class. At present, a manuscript is being prepared in the section, for an Ordnance Department Manual entitled "Elements of Motor Carriage Design." The manual will be similar to the Department's "Elements of Mobile Carriage Design," and will completely cover all factors and calculations necessary in the design of a motor gun carriage.

The preparation of War Department specifications governing the manufacture of mobile artillery carriages and vehicles, and of such automotive equipment as is procured by the Ordnance Department, is performed by the design section. Here again the shop men of the Arsenal are freely consulted, and advice from commercial concerns is frequently sought. When finished, the specifications are submitted to the Ordnance Office for its action and approval. The problems involved are many and varied, and an immense amount of detailed study is necessary to assure a specification which adequately protects the War Department, and yet which conforms closely to commercial practice, so as to permit of ready production in time of war. The great importance of this work is at once apparent.

The automotive research laboratory is also directly under the officer in charge of the design section. However, due to lack of funds, but little work is now being done under this activity. The equipment of the laboratory is very incomplete and would have to be greatly augmented to carry on a serious or elaborate automotive research problem.

In all of the research and development work assigned, frequent detailed reports of progress are made to the Ordnance Office, so that the work may be properly coordained and shaped to the end in view.

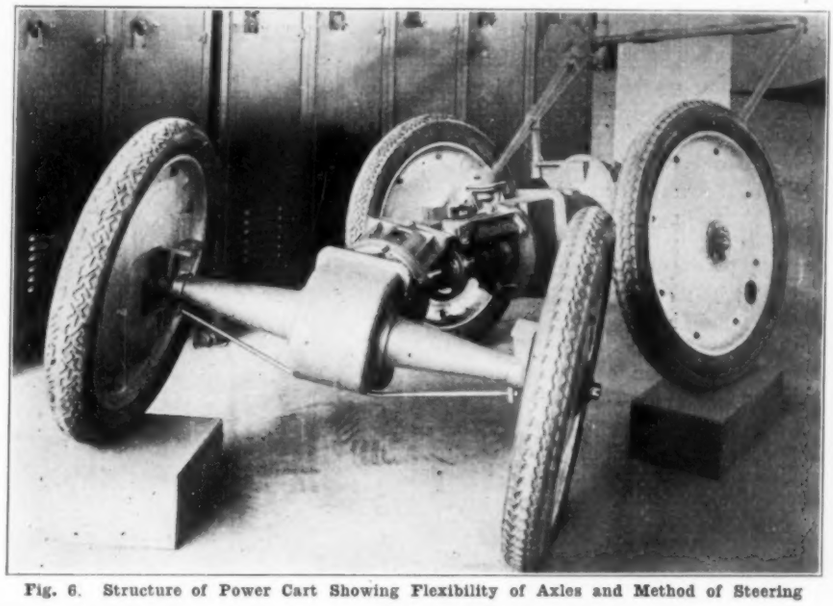


Fig. 6. Structure of Power Cart Showing Flexibility of Axles and Method of Steering

School of Ordnance Design

Before proceeding to outline the designs being carried forward in the section, it is desired to refer to the school in design being conducted for student officers. There are four officers assigned to duty as students, whose time is engaged solely as such. The course covers two years, and is divided equally between mobile gun carriage design and automotive design. Two officers are at present taking each subject, and upon satisfactory completion, the students will be shifted to the other. In this way, an officer has the opportunity of experience in both lines during his assignment. If, after a few months, the officer does not show sufficient aptitude, potential ability as an engineer, or application, he is usually assigned to other duty

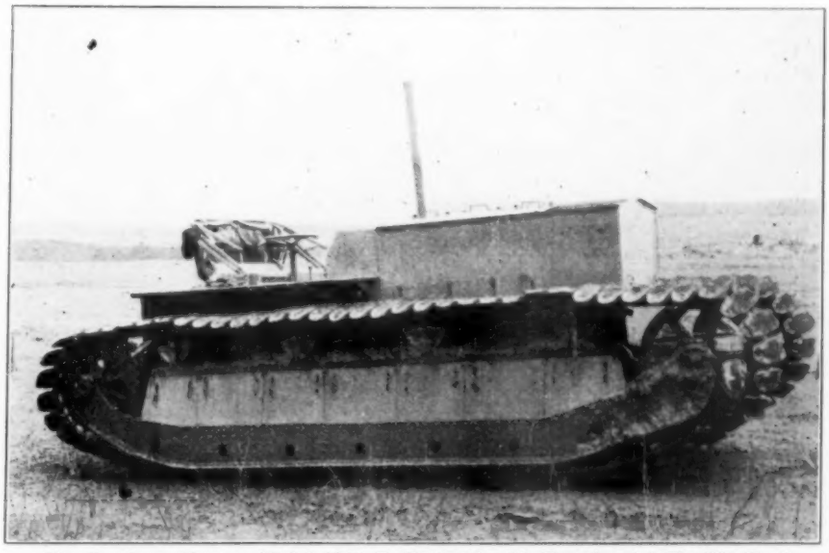


Fig. 7. Army Tractor, Model 1922 E, Equipped with Experimental Flexible Track

by the Ordnance Office. The mere fact that an officer does not develop ability or liking for design while in the course, should not and is not, held against him, as it is recognized that all men are not engineers, neither are they bankers, doctors, or aviators. The officers selected for the course are usually taken from those graduates of the Ordnance School at Watertown Arsenal who are considered to have shown the greatest promise for design work.

The course in mobile gun carriage design is divided into two parts, (*a*) General, which consists of an extensive series of theoretical problems covering mechanical engineering as employed in carriage design, (*b*) Mobile Carriages, in which is studied the practice of carriage design obtaining in the Ordnance Department. In this portion of the course various carriages are studied, calculations covering all features are made and checked against the actual design. Finally, the design of a field gun carriage of selected type is undertaken. This work will involve the preparation of study drawings of a carriage designed to meet certain specifications as to weight, traverse, elevation, maximum range, etc. All forces and reactions throughout the carriage will be calculated, as well as the strength of various components, while preparing detailed drawings. At some convenient time during the year, the officers in this course, are given a practical course of instruction in the operation, adjustment, maintenance, assembly and disassembly of recuperator mechanisms. They work in pairs and perform the actual operations on the recuperator, under the supervision of one of the civilian experts employed by the Arsenal. The instruction is sufficiently extended to assure that the student is quite thoroughly familiar with the practical operations met with in mechanisms of the type he has to design during his course, and with which he will come in contact throughout his future service in the Department.

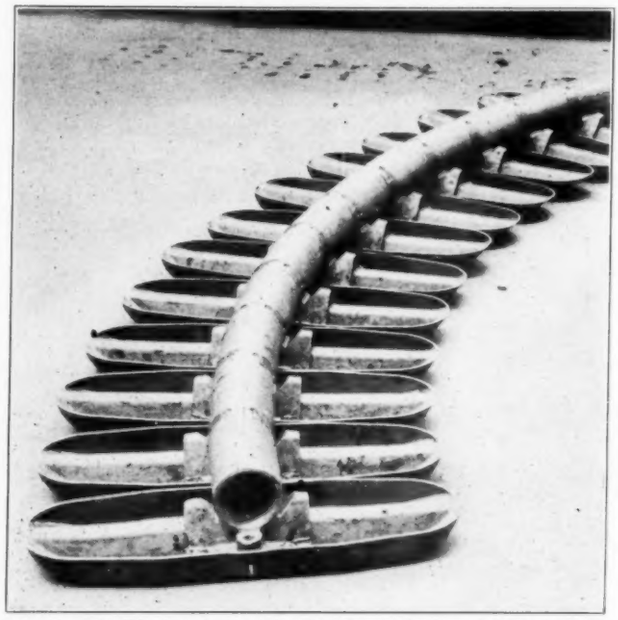


Fig. 8. Flexible Track Tested with Army Tractor, Model 1922 E

The automotive course consists in the solution of practical design problems covering the entire range as met with in the design of a tractor, motor gun carriage, or tank. For example, the student is given specifications covering an engine for a 10-ton tractor, and is required to design the engine and to make all necessary calculations incident to the design. He then prepares outline drawings showing longitudinal part section, and transverse section of the engine. The same procedure is followed for clutches, transmission, universal joints, final drive mechanisms, brakes, track-shoes, suspensions, etc. Ground pressure diagrams are prepared for various draw-bar pulls with various grades. Performance charts are prepared for various assumptions of draw-bar pull, coefficients of rolling resistance, and grades, as well as charts showing hauling capacity and other data.

A definite time is allotted to each problem, so that the student can gauge his time for completion of the course. Throughout he is free to consult with the engineers and draftsmen in the section, many of whom have had wide experience in commercial practice, and to observe designs in progress. It would appear that much work is crowded into the time allowed, but the fact should not be lost sight of that the officer has no routine duties to perform, and nothing to distract his attention from the business at hand. Also, the winter nights of northern Illinois are long. It is hoped by means of the course and direct contact with the drafting room, to train a number of officers in Ordnance design, and in the proper management of a design force. For those who like, and are adapted to, design work, the opportunity offered in pursuing the course of the design section, is indeed exceptional.

Work Done by Design Section

To return now to the designs in process at the Arsenal, perhaps it may be well to give a partial résumé of the expenditure orders on which work is being done, with brief remarks for each.

Exp. Order 8097—1 Medium Tank, Model 1921, and 1 Medium Tank, Model 1922. These tanks, which were designed and manufactured at the Arsenal, are now undergoing tests at the Aberdeen Proving Ground, and occasional changes in drawings are made here as a result of developments incidental to the test. In an effort to keep the designers here in close touch with the tests of matériel at the Proving Ground, daily log sheets of tests are forwarded direct by the Proving Ground at frequent intervals. In addition, progress reports of tests are received through the Ordnance Office as issued. The tests of these tanks are of particular interest at present, as it appears probable that a new medium tank will be designed embodying very closely the general characteristics of the Model 1921.

Exp. Order 8778 covers the design of the new medium tank, on which the section is working in close cooperation with the Ordnance Office. The design has not yet progressed to the stage where accurate detailed information may be released.

Exp. Order 8870 covers the development of the Chase type of track for application to cross-country infantry and artillery vehicles, under which experiments have been carried on here for the past two years, and at other places for some time prior thereto. A type of fabric track with special alloy steel connecting bars, has been fitted to a light truck equipped with an additional pair of wheels carried on a dead axle placed just in front of the rear axle. The track is carried over and around these two rear wheels on each side. Considerable difficulty was experienced in driving the track and several types of

driving lugs were designed and tried. Finally a very satisfactory type was evolved.

Figure 2 shows the track and driving lugs fitted to a light truck equipped as above. In order, however, to secure a better action between the tires and the track a driven axle was substituted for the dead one just described. By its use the necessity of driving lugs has been eliminated and the action of the track greatly improved. Figure 3 shows the truck provided with an additional driven axle. Note also the track adjustment whereby the distance between axles can be varied.

For purposes of comparative test, the same truck has been equipped with balloon tires. By a thorough test under identical conditions of terrain and load it will be established by the Proving Ground as to whether the complications of a track afford sufficiently increased maneuvering ability of the truck over the balloon tire equipment. Unless the increase in ability is very material it would not appear advisable to proceed with this development.

Figure 4 shows another type of track of rubber-covered fabric. This particular type was found unsatisfactory in snow, ice, and soft mud, due principally to the depressions in the tread becoming packed and thus causing the track to present a perfectly smooth surface, with resulting loss of traction.

Exp. Order 8960 covers the development of track and suspensions of the power-cart class. This vehicle is desired by the Infantry for use as a "mechanical mule." Several vehicles have been designed, built and tested, embodying the the tractor type of drive and steer. The weight limit prescribed is of necessity so low that the vehicles all proved mechanically unsatisfactory in test. The Arsenal then presented the idea to the Ordnance Office, which gave its approval, of a design very similar, in so far as the type of drive employed, to a four-wheel drive tractor or truck. Provision is made for use of a fabric type track, should the balloon tires and Weed chains not give sufficient "mud-hog" ability to the vehicle. The design is unique in the degree of flexibility between the two axles, and in the method of steering.

Figures 5 and 6 of the wooden model give a clear idea of the vehicle. Power will be furnished by a commercial two-cylinder air-cooled motorcycle engine of 61 cu. in. capacity. A light body is to be provided for carrying any of the infantry accompanying guns set up on their own wheels. Provision is made for man-handling the vehicle across trenches and towing hooks are fitted so that the job may be assisted by men on drag-ropes in unusually severe going. The estimated weight is 750 pounds, with 450 pounds carrying capacity, and the speeds provided vary from 1.5 to 4 miles per hour. The operator walks behind the vehicle.

Exp. Order 9129 covers the design and manufacture of a track-laying adapter for Fordson tractor, which work has been assigned to the Arsenal by the Ordnance Office. Studies of two adapters, one of the "half-track" type and the other of the "full-track," have been proposed and are now in the Ordnance Office for its action. The adapter is, practically speaking, a wheel of caterpillar type periphery to be substituted for the wheels on the standard Fordson to increase the ability of the tractor to operate over soft ground.

Exp. Order 8116 covers the Army Tractor, Model 1922, the design of which was detailed at the Arsenal from designs sent out by the Ordnance Office. The design was based on patents of a British concern. The tractor, as built, was equipped with the controlled differential type of steering, a flexible or "snake type" track, and a chain suspension for the truck wheel bogies. Flexibility of the track is obtained by connecting the circular rails of the links by means of a bolt and ball-joint. This permits of laying the track in a curve when turning, obviating the necessity of sliding it over the ground sidewise, as is done in the case of the conventional type of track-laying vehicle. The track links are inter-communicating at the joints, which are lubricated by heavy oil contained in the barrel of the circular link. As long as it is possible to keep the dirt and grit out of the oil, wear at the joints, with resulting track "stretch," is small. After manufacture of a vehicle, a brief shop test to remove the "bugs" is always given. During the shop test of the tractor it was found to be impossible to keep the dirt out of the link. The wear was so rapid as to cast serious doubt as to the practical field use of this particular type of track. This development is suspended, at least for the time being. Figures 7 and 8 show the Army Tractor, Model 1922, and emphasize the extreme flexibility of the track.

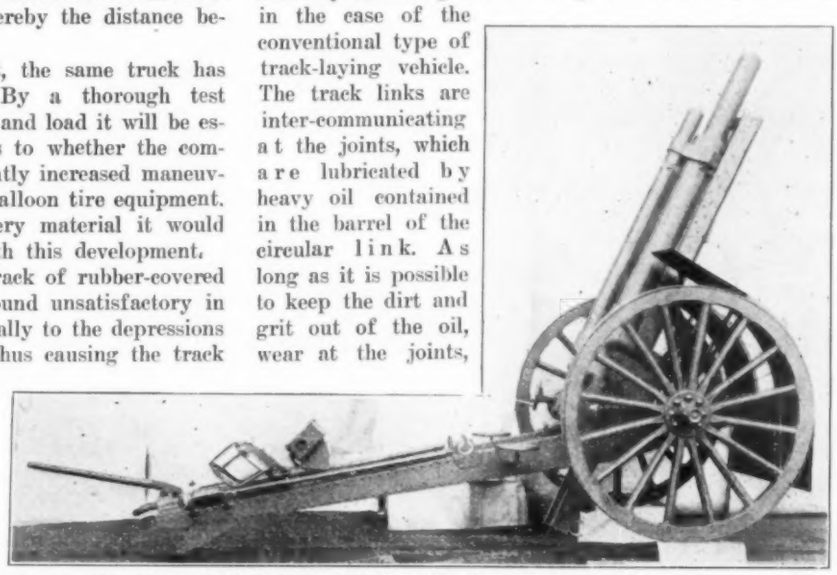


Fig. 9. The Experimental 105-mm. Howitzer Carriage, Model 1925 E; right side, firing position, 65° Elevation

Several other projects on which the section is engaged offer no particular features of interest and will, therefore, not be touched upon in this brief article.

Among the projects being carried out in the mobile carriage unit of the design section, the following are illustrative of the character of work being performed.

Exp. Order 9025 covers the design of the 155-mm. Howitzer Carriage, Model 1925-E. All work in connection with this carriage is being done at the Arsenal, subject, of course, to the approval of the Ordnance Office. Studies prepared have been approved, and detailing of the design is now being carried on. A wooden model is under construction, which when completed, will be shipped to the Ordnance Office for examination and criticism by that office and officers of the Field Artillery, after which all recommended changes will be incorporated in the carrage to be built later. Effort is being made to follow closely the design of the very successful 4.7-inch Gun Carriage, Model 1921-E, with changes that have been found desirable during test of that carriage. The general specifications under which the carriage is being designed provide for a maximum elevation of 65 degrees, with range of 16,000 yards, firing a 95-pound projectile; a total traverse of 60 degrees; and weight, without limber, of 13,000 pounds.

Exp. Order 9029 covers the design of the 105-mm.

Howitzer Carriage, Model 1925-E, from studies prepared in the Ordnance Office. This carriage, of the box-trail type, offers a departure from previous American carriages in that the recoiling parts are weighted by the addition of a sleigh, which also permits of the gun being retracted for road transport. A wooden model was constructed, and the carriage is now under manufacture. The howitzer has a maximum elevation of 65 degrees, a range of 12,000 yards, firing a 33-pound projectile; axle traverse to a total of 8 degrees is provided, and the weight of the carriage, with limber, is 4,500 pounds.

Fig. 10. 75-mm. Pack Howitzer Carriage, Model 1923 E, Left Side, 0° Elevation

Figure 9 shows the wooden model of this carriage, from which the general features are clearly apparent.

Exp. Order 9180 covers the completion of studies prepared in the Ordnance Office in sufficient detail for the construction of a wooden model of the 75-mm. Gun Carriage, Model 1925-E. The studies provide for a box-trail carriage, embodying changes found desirable in previous experimental models constructed since the Armistice. Axle traverse of 10 degrees, and elevation of from —5 degrees to +50 degrees is specified. The weight of gun and carriage is estimated as approximately 2,900 pounds. The wooden model is now being constructed.

Exp. Order 9144 covers modifications to the 75-mm Pack Howitzer Carriage, Model 1923E, No. 1, and manufacture of a second carriage, Model 1923E. The pilot carriage has been tested by both the Proving Ground and the Field Artillery, and the re-design embodies all recommended changes. The carriage provides a maximum elevation of 45 degrees and a traverse of 5 degrees, giving a maximum range of 9,000 yards with a 15-pound projectile. The total weight is approximately 1,300 pounds, and for mule packing, the carriage is divided into 6 loads; that is, howitzer tube, wheels and breech, front trail, cradle and top sleigh, bottom sleigh and recoil mechanism, rear trail and axle, each load being approximately of the same weight. Fig. 10 shows the carriage in firing position.

Adjustable Pneumatic Equilibrator

A very interesting problem in design is being met with in the design of adjustable pneumatic equilibrators. It has been found that due to the effect of changes in temperature, the air under compression in the equilibrators is subject to change in pressure, thus increasing or reducing the normal designed pressure. This results in quite a wide variation in the effort to be exerted at the handwheel for elevating or depressing the gun. A series of experiments has been conducted, and a design of an adjustable equilibrator prepared and submitted to the Ordnance Office, which will compensate for a wide range of variation in temperature. In general, the design provides for varying the effective length of the equilibrator arm proportionately to the change in temperature, thus maintaining a constant effort of the equilibrator, and uniform handwheel load. It has been recommended that adjustable equilibrators be manufactured for the 155-mm. Gun Carriage, Model 1920E, to test the principles involved. The recommendation has been approved, and manufacture is proceeding at the Arsenal. Should the design prove satisfactory, doubtless, carriages to follow will incorporate this feature, which should be of especial value in the case of antiaircraft carriages, in which ease of operation means rapidity and volume of fire.

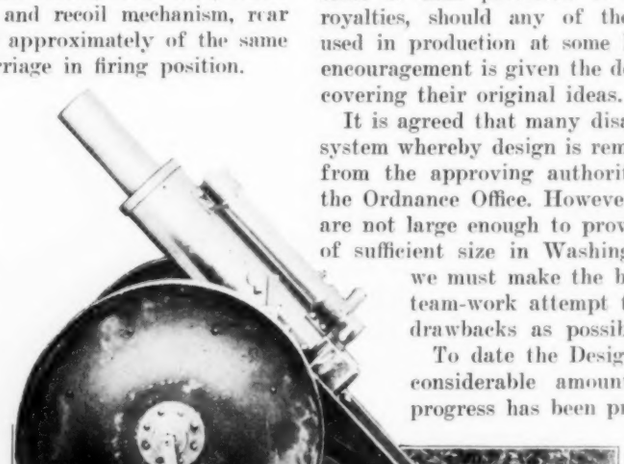


Fig. 11. 75-mm. Mortar Carriage, Model 1922 E, Left Side, 45° Elevation

The 75-mm. Infantry Mortar Carriage, Model 1922E, has been redesigned under Exp. Order 9132, to incorporate in carriage No. 2 all changes recommended incident to test by the Proving Ground and Infantry Board at Fort Benning. The carriage is now under manufacture. A maximum elevation of +45 to 65 degrees, and traverse of 10 degrees, is provided. The maximum range is 1,850 yards with a 12-pound projectile. The weight of gun and carriage is approximately 300 pounds, which may be divided for carrying, into four loads, as follows: Howitzer, 75 pounds; wheels, axle, etc., 75 pounds; trail, 75 pounds; cradle and recoil mechanism, 75 pounds. Fig. 11 shows carriage No. 1, which is essentially like carriage No. 2 now under manufacture.

Frequently during design, various constructions are originated which are patentable, and quite a large number of patents and applications have been either granted to or filed by the personnel of the section. The Government is thus protected from liability of payment of royalties, should any of the patented constructions be used in production at some later date. Therefore, every encouragement is given the designers to apply for patents covering their original ideas.

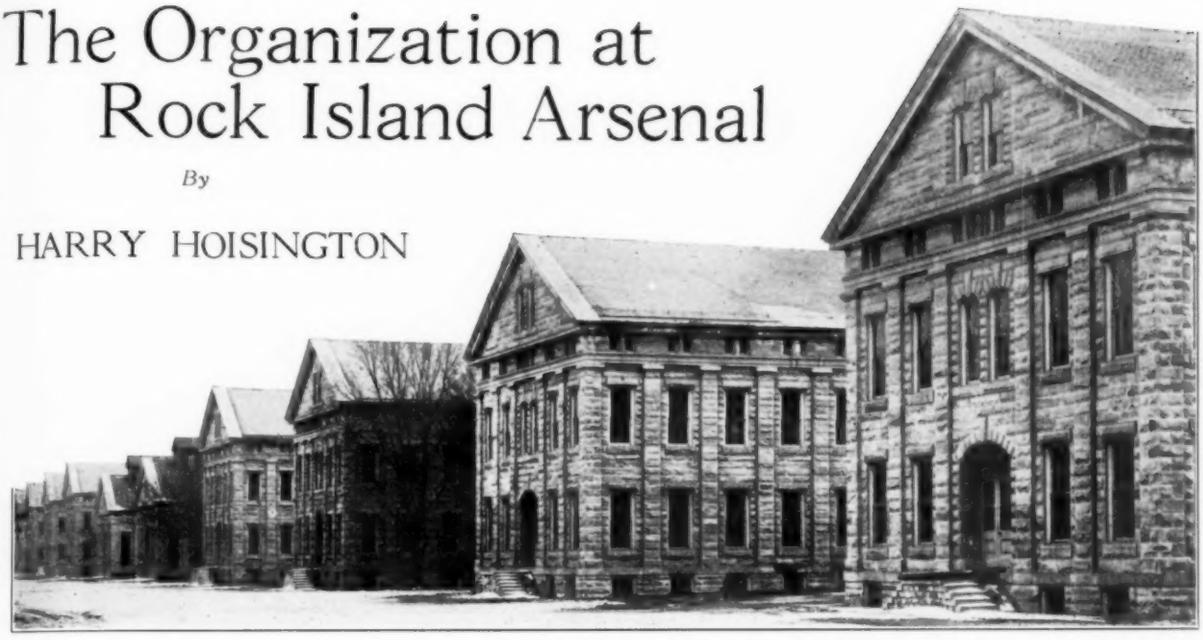
It is agreed that many disadvantages are inherent in a system whereby design is removed to such a great distance from the approving authority, as is the Arsenal from the Ordnance Office. However, as long as appropriations are not large enough to provide for maintaining a force of sufficient size in Washington to carry on the work, we must make the best of the situation, and by team-work attempt to overcome as many of the drawbacks as possible.

To date the Design Section has undertaken a considerable amount of important work and progress has been proportionate to the time and effort expended by it. Ordnance design is a very important phase of the general ordnance problem: as design develops and progresses so does the entire art. At Rock Island Arsenal it is going forward apace.

The Organization at Rock Island Arsenal

By

HARRY HOISINGTON



Rear View of Armory Row of Shops, Rock Island Arsenal

A GREAT many years ago Commanding Officers of Armies found that they secured best results by dividing their commands and allotting specific duties to each unit. Military men today, when the subject of method in industry is approached, are wont to remark that modern industrial organization is but another of the superlatively great benefits which have come to mankind directly or indirectly through war activity. Whether this be a true thought or not, the fact remains that the work of the world is to-day quite generally carried on in an orderly and predetermined manner. Every industrial plant of any importance is now organized with a view to making the most of its resources.

A manufacturing arsenal, like any other great factory or enterprise, must be organized. The work is not simply one of putting some metal into some machines which make a turn or two and spout out a complete tractor eager to pull a 155-mm. howitzer carriage ten thousand miles. It is, instead, essential that every detail of manufacture be considered in advance.

Were a company of reserve Ordnance Officers to receive suddenly directions to take over control of a big shop in some industrial center and make a manufacturing arsenal out of it, the commanding officer would immediately find his organization differing in some respects from the lines so often found in commercial enterprises. No selling agency, for instance, will be required. The work of finding out what is to be made is done by the Office of the Chief of Ordnance. Theoretically, the Ordnance Office knows now, or shortly will know, exactly what it will want each of its manufacturing plants to make and just how each article is to be made. Inventions and procurement of patents and such associated engineering work can not be undertaken to any great extent at an arsenal in war time. There is little fear but what in a war emergency the Ordnance Office will find something for its arsenals to do. It will find a number of things of differing kinds that we have never made before nor perhaps heard of and it will demand what may seem a most unreasonable quantity of them in a ridiculously short time. How shall the arsenal be arranged so that it can get its product shipped out at least fifteen minutes before the expiration of the time limit?

Particular systems of management used by the Ordnance Department are not established by Acts of Congress. Several years ago efforts were made to install methods and devices long since adopted by industrial concerns, but the attempt did not succeed. Legislation has, therefore, been somewhat restrictive rather than constructive and the use of the stop watch and time study, for example, is prohibited in government work shops.

Necessary Procedure

Having an order for a given quantity of an article, the procurement of necessary material would appear to be a natural sub-division of the work. The procurement and attachment of the necessary personnel is a second. The arrangements for paying for that material and that personnel another. The transfer of material to the shop; actual shop fabrication and assembly of the parts; inspection and test; painting, nickel-plating or other finishing and preparation for shipment, are other usual commercial branches of organization.

Shops cannot start work without the material to work on or tools to work with; inspection and shipment certainly cannot precede fabrication; and so it appears that the *time element* demands consideration and will require schedules of operations. Before any department begins work it must have certain information. The procurement man is not going to ask merely, "How much stuff do you want?" but, "What is the smallest amount, of what sizes, of what particular and unusual kind of steel, rubber, paper, bronze, gold, silver, nitrogen, cloth or what not, can you get along on if I get it to you by the last of next December?"

The Employment Section most unreasonably demands to know not "How many men do you want?" but "How many and how good tool makers, lathe, shaper and milling machine hands; draftsmen, blacksmiths and sweepers have you got to have and which ones first?"

Yes, the Chief of Ordnance will find something for us to make; but even the Ordnance Office plans change and that Office is likely to start asking such questions as "Can you make 42,967 155-mm. high explosive shells fully charged with TNT in two weeks, and how much will it cost?" So we have got to have somebody to think up answers to such questions.

The Organization Chart

The details of the Organization Chart of Rock Island Arsenal are for the commanding officer to decide and the present chart represents his ideas or modifications of the ideas of his predecessors. Each sub-division of the work has been made with a definite purpose in view and, as far as practicable, each movement is determined and ordered in advance. It will be noted that at present Rock Island Arsenal is considered as five major departments in agreement with the general Organization Plan adopted by the Ordnance Office. It is possible to expand this organization or to contract it according to the circumstances or business of the Arsenal. With the Arsenal on its present very limited activity, a number of the sections are combined, possibly under a different actual heading, but technically they remain as on the chart. There have been regular army or reserve officers tentatively assigned to definite places as heads and assistant heads of the various units. The commanding officer, in war time, is supposed to be a brigadier general. A Colonel is assigned to the office of the Executive Officer. Five lieutenant colonels, sixteen majors, twenty captains and nineteen lieutenants are included in the tentative war time staff, exclusive of medical and dental officers and of officers of the attached troops.

Referring to the Organization Chart as a wartime chart, the duties of at least the principal sub-divisions may be rather generally considered as follows:

In the Administration Department, perhaps we may skip the Adjutant's Office, Police and Fire Section, Enlisted Personnel, Military Personnel, Military Hospital, in fact, the entire military division with the remark that those duties are obvious. It may be said that the Transportation alluded to as connected with the Quartermaster Section is that of individuals and freight leaving or arriving at the Arsenal rather than that of the necessary movement inside the plant. For the Civil Division of the Administration Department, the duties of the Employment Office, Mail and Record, Purchase and Pay or Finance Section, are much as usual in commercial work. The Allotment Section is necessary to keep expenditures under the proper appropriations. The Welfare Section may supervise the safety measures, cafeteria, Arsenal Band and sports. The Civil Service Office insures fidelity to the Statutes of Congress affecting employment and separations. The Compensation Office and Civilian Hospital is well equipped for first aid service and insures conformity to laws specially applicable to employees of the government. The office at Rock Island Arsenal is in charge of an official of the Public Health Service and serves Post Office, Engineer Corps and all other governmental employees in the vicinity. The Plant Engineering Department handles matters pertaining to the power, water, light and heat, the construction of new buildings, the upkeep of viaducts and bridges, railroads, etc.; and also administers the facilities for automotive transportation, which is almost entirely within the arsenal reservation.

In the Manufacturing Department, the Property Division handles raw materials for manufacturing; procures and records shop and office furniture, machinery, etc., and stores such jigs, fixtures and tools as are not in use. The Production and Engineering Divisions function as like divisions of commercial plants. It will be observed that the Inspection Department is entirely separated from the Manufacturing Department. The Ordnance Office insists upon this that inspection may in no way be prejudiced in favor of the shops. It does not mean that inspection must take place in a building other than that in which the parts are manufactured, but that the inspection personnel shall be wholly relieved from the necessity of compliance with orders issued by any person in the production management who might be tempted to direct the acceptance of under-grade work. Of course, the provisions in Ordnance general specifications that all operations of manufacture be open to Ordnance inspectors apply at arsenals and the inspectors watch every process and advise the production management of any doubtful procedure they may observe. It is strictly up to the Chief Inspector to see that every manufactured article that leaves the plant is exactly what it is supposed to be, but rejected work means loss to the War Department of valuable time in delivery and he is expected to discover errors and make his necessary condemnations of parts as soon after the errors are made as is humanly practicable and in this way his department becomes cooperative with, not antagonistic to, the Manufacturing Department. The Proving Ground is a section of the Inspection Department.

Going a little farther into the scheme of organization, we find that it has been necessary to reduce the paper work as much as possible, and as much of this contains cross references to various divisions and sections, each division and section has been assigned a symbol which can be used on the paper work instead of the full name of that section. Referring to the Arsenal's Book of Symbols we find a more or less detailed description of the activities covered by each department or section; also that symbols are assigned to many other activities, things and charges; the principle being carried to the extent of assignment of symbols to each particular jig and fixture, to each printed form used, and to piecemarks which are as far as practicable stamped on each individual component part manufactured or handled. Further, there are laid down regulations, or "procedures," for the use of these symbols and for the way in which each section is to do its work, even as to how the mechanic in the shop shall assemble a job in the machine and at which particular machine he is to work. Reserve Officers generally express relief when it is explained that their prospective duties are thus predetermined, that they are told exactly what to do and will not, therefore, have to decide on all these matters. It is sometimes delicately hinted to a new officer that his advocacy of changes in established procedures had best not be hurried until such time as he is thoroughly familiar with all of the points involved in that change, as almost everything that is laid down has been *tried out* and most of it in several different forms.

Progress of a Work Order

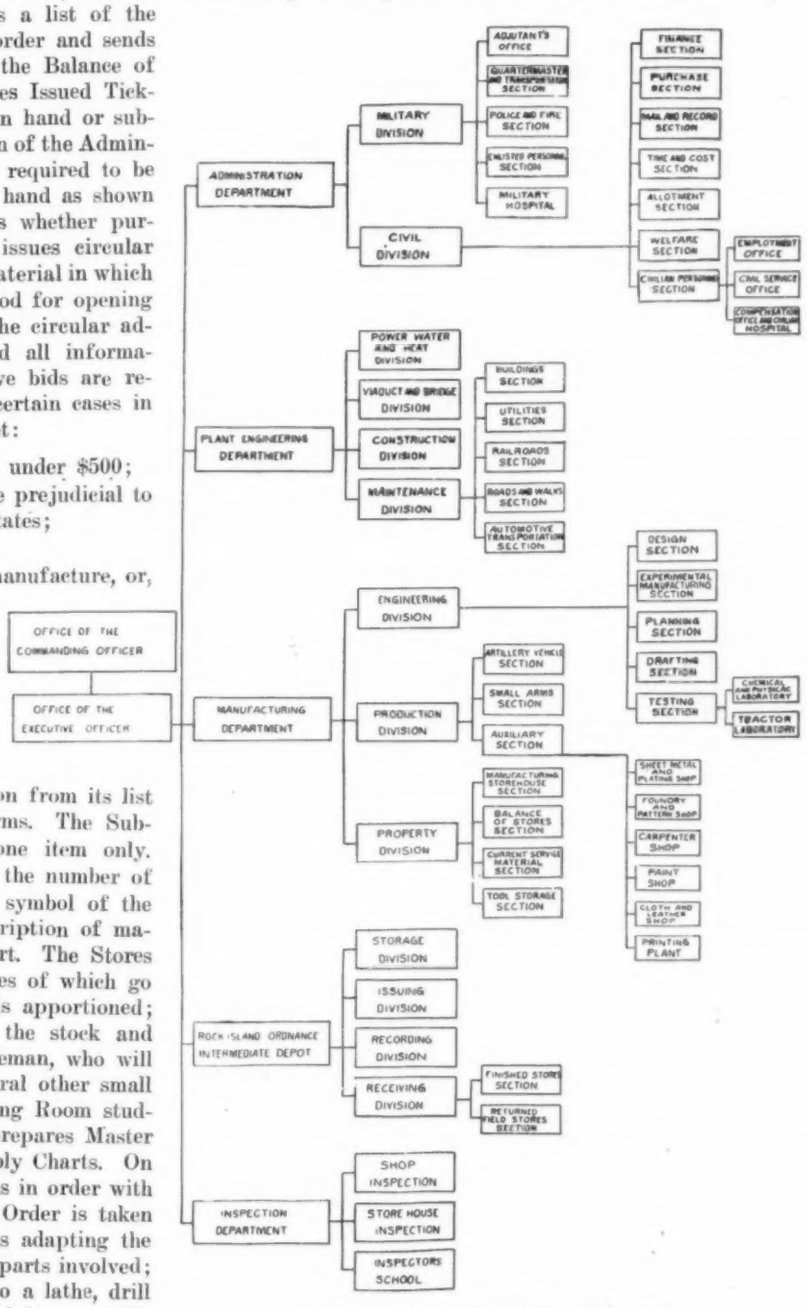
Now, let us trace the progress of a Work Order through the various departments of the Arsenal. Upon receipt by the Arsenal of an order to manufacture, with an allotment of funds, the order goes to the Allotment Section where an allotment number is assigned serially in sequence of its receipt and a record made on the Allotment Record Card. The number assigned to the allotment of funds be-

comes a number for an Expenditure Order or order to the shop. The Expenditure Order is a mimeographed publication issued by the Engineering Division giving all available information about the order. This is sent to the various departments for general information. Working from the data set out in the Expenditure Order, the Engineering Division Planning Section issues a list of the parts and number of each covered by the order and sends Stores Issued Tickets for the material to the Balance of Stores. From the information on the Stores Issued Tickets the Balance of Stores sets aside stock on hand or submits a requisition to the Purchasing Section of the Administration Department for such items as are required to be purchased. The condition of the stores on hand as shown by the Balance of Stores books determines whether purchase is justified. The Purchase Section issues circular advertisements for the furnishing of the material in which a date is set for opening of bids. The period for opening of bids is usually ten to fourteen days. The circular advertisement contains full specifications and all information concerning the items. Such competitive bids are required by law for all purchases except in certain cases in which purchase can be made in open market:

(*a*) If the amount of money involved is under $500;
(*b*) In emergency, where delay would be prejudicial to best interests of the United States;
(*c*) If the article be patented;
(*d*) If the material involves secrecy in manufacture, or,
(*e*) Where advertisement has been made and the bids received are not satisfactory.

When material is received, it comes into the Receiving Storehouse which reports to the Balance of Stores the fact of its receipt.

The Engineering Division Planning Section from its list of parts makes out a number of other forms. The Sub-order is a form generally referring to one item only. It states what department starts the work, the number of pieces to be made, the name and drawing symbol of the part, and generally the quantity and description of material which has been provided for this part. The Stores Issued Ticket is another form, several copies of which go to the Balance of Stores where the stock is apportioned; thence to the storekeeper who sets aside the stock and thence to the Shop Planning Room, or foreman, who will actually draw the material. There are several other small forms of occasional use. The Shop Planning Room studies the list of parts and the drawings and prepares Master Route Sheets (or Shop Orders) and Assembly Charts. On the Route Sheets are set down the operations in order with notes as to helpers needed, etc. The Shop Order is taken from the Route Sheet and Assembly Charts adapting the Master Route Sheet to the particular lot of parts involved; that is to say, it directs the material sent to a lathe, drill press or wherever the first operation (machining or drilling of a certain hole or other particular operation) requires, then to the next machine and the next, etc., with full information as to what is to be done at each operation. The Assembly Charts are similar to Route Sheets and have to do with the putting together of finished components. The Route Sheets (or Shop Order) and Assembly Charts are prepared and kept on file in the Planning Room until Job Cards, Route Tags and Identification Tags are made out. The Identification Tag is a cardboard tag tied onto the article or container of a number of articles and follows it through the shop. The Route Tag is a cloth tag on which is typed a synopsis of the route to guide the moveman. When the time has arrived for the shops to start work on the material, the Sub-orders and Stores Issued Tickets go to the foreman with Shop Orders, Job Cards and Identification Tags.



Organization Chart of Rock Island Arsenal

The Job Card explains a particular operation. There are a number of copies of this paper. When the foreman is ready for the workman to start on that operation, he hands the workman his copy of the job card. The workman exchanges the foreman's copy of the job card at the job card window and gets his own copy in return with the time stamped on it. The material is already delivered at the proper machine accompanied by a copy of the Shop Order. When the workman has

finished the work, he turns the Job Card back to the window and the attendant stamps the time of return on it. The inspector is notified and the part is sent to the inspection crib. The inspector gets a Job Card, looks over the work and passes on it, then turns in his Job Card in a similar manner. The part is stamped with its piecemark in the inspector's crib and then transferred to temporary store until wanted on the assembly floor. When a sufficient number of parts have been completed they are called out to the assembly floor and put together. No parts can be assembled which do not bear the inspector's mark. The assembled vehicle is inspected; should it be a gun carriage, it is proof fired and road tested, then painted and turned over to the Stores Division for shipment. Duplicate job cards drift back to various departments for record; for example, the job cards are turned in marked "Parts finished"; a copy goes to the Planning Room where the information is noted on the progress chart and copies are sent to the Time and Cost Division for their reference. It will be noted that a considerable number of records are kept; everything must be accounted for, receipts are given and taken when material passes between departments.

Records of work and of money and time expended on the job must be kept as a proof that instructions have been carried out with exactitude.

The Human Element Slips a Cog

Now, organization plans and procedure must also consider changes in schedules and correction of errors. Trains do not always run on the tracks provided for them. There is many a chance that change in original plan, failure to get material, receipt of wrong material, or error in the shop will upset the schedule; then someone must get busy and straighten things out. There will be error and its amount will depend in part upon the thoroughness of discipline. Error is not always the result of carelessness; it sometimes results from overzeal. Suppose our orders are hastily prepared in Washington, and the allotment of funds and other details are inexact. Resulting passages of papers between branches and between the Arsenal and Ordnance Office may resemble the French game of "Selling the duck." Then, after the preliminaries are adjudged correct, we may wait some time for a forging of an axle or a billet for a cradle, and flaws develop in the forging, or the billet shows inclusions in the steel after much valuable time has been spent in machining. Perhaps we reject a bar of special steel intended for a certain piston rod and after several weeks get in the replacement material. It is put into a lathe and the workman starts a roughing cut up to a shoulder on the rod. Just as he is standing set with his hand on the shifter rod and tool running perilously close to the mark, the *fire drill gong* is sounded about three feet from his ear. It is not a feeble gong and the startled operator jumps about six inches in the air and by the time he recovers and shuts off his machine the cut has run one-eighth of an inch too far and that precious rod is below dimension for length. Well, he goes immediately to his foreman and confesses with tears in his eyes. The foreman takes a swift look and a swift thought and tells the man to start a finishing cut while he starts for the officer engineer overhead. He reports to his officer that undoubtedly the inspectors will reject this rod if finished, but that in his opinion the shoulder in question is not so important as a total loss on that rod would be. Now, the officer must be *sure* of his facts. He calls on the Ordnance Engineer if he is not sure.

There may be some assembling question involved if not one of function or strength. Having decided that the foreman is right he may dictate a memorandum for the initials of the Works Manager and Executive Officer:

"Expenditure Order No. 1.

One experimental piston rod, drawing C2001, has through error, been machined .125 short on dimension 5. $\pm^{.000}_{.005}$. The dimension is deemed unimportant as compared with the loss of the rod and the piece will be completed to the remaining dimensions. Inspectors will note upon the form report for this vehicle. Lt. Col. ——— will explain to the Chief of Ordnance.

(Signed) X Y Z, Executive Officer.
J K L, Works Manager.
By Lt. R."

and over the phone:

"Hello! Plant Engineering. Isn't there some way you can tone down the first few strokes of that fire gong? No? Well, then move No. 28 a few feet away from lathe No. 656. We've just lost a piston rod on account of it. Thank you."

Then, in the shop the foreman writes an abbreviated statement of the case against the workman on a form provided for the purpose and sends it to the Master Machinist for his initials and recommendation of penalty. The Master Machinist sends it on to the Executive Officer and from there it goes to the section responsible for the carry-out of the penalty and is finally attached to the efficiency record of the employee.

What the Works Manager and Executive Officer say when they receive the memorandum of Lt. R. need not be set down here. If the Executive Officer signs it, the piston rod proceeds to the assembly floor and the Executive Officer may be depended upon to examine the form report for that carriage to see whether the inspectors have duly noted the deviation from the drawing.

It will be realized that it has here been possible to mention the more general paper forms and procedures and that every department has its own regular and emergency series. In peace time, the Design Section and experimental work at the Arsenal make up a far greater proportion of the activity than in war. The organization must also be readjusted to handle work from various other departments such as the Air Service, Engineer Corps, Reclamation Service and Signal Corps.

The writer has attempted to show the necessity of organization, and the organization plan must

Be comprehensive and elastic;

Conform to law as to restrictions and disbursements of public money;

Provide for records of expenditures;

Provide for individual records of each employee;

Provide for a smooth and efficient working schedule and reports of progress of work;

Provide for corrections of error;

Provide for maintenance and protection of the plant, and,

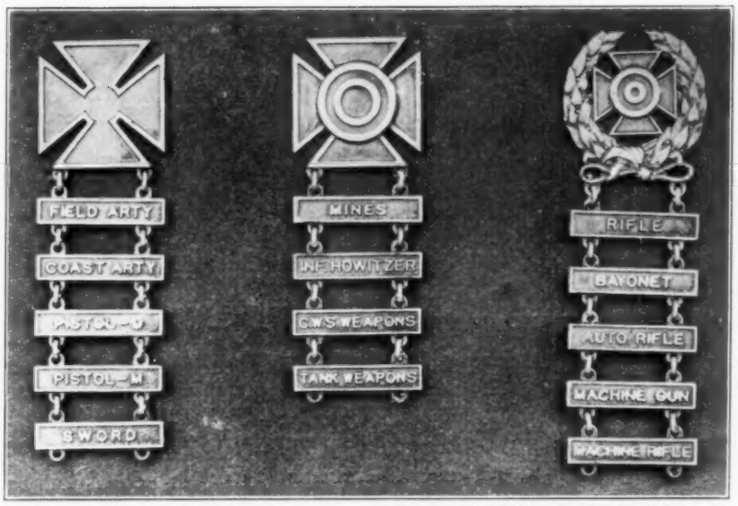
At least, presuppose discipline.

Manufacture of Equipment at Rock Island Arsenal

By

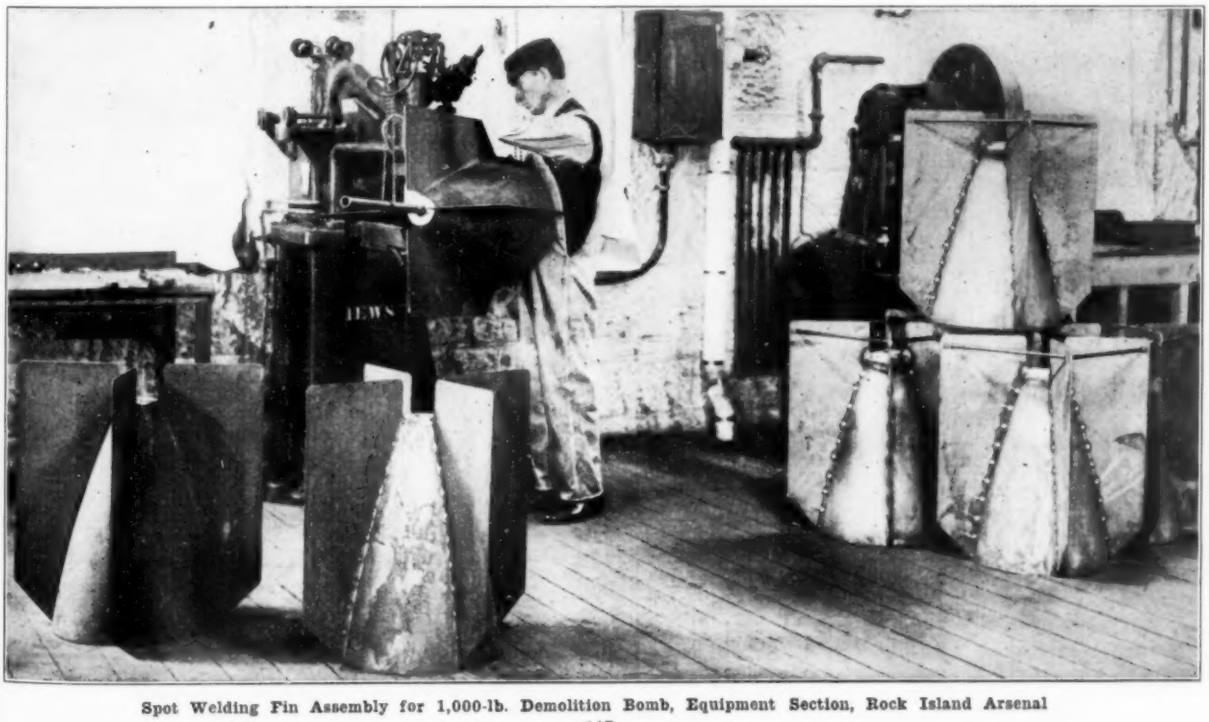
CHARLES R. PETERS

THE name "Equipment" as applied to military supplies could reasonably be construed by the layman as covering items which in commercial life would probably be manufactured in a novelty works. This conception is correct to a certain extent, but when applied to the Equipment Section at Rock Island Arsenal, a broader and more flexible construction seems more applicable. This section has for many years been a manufacturing center and I believe that for reliability and adaptability in any emergency it has always been among the foremost. Though the name equipment has been retained, its adaptability is exemplified by the fact that while the work of providing horse and man with equipment has been practically removed from our province, we have today a comparative working organization equal to that of other sections and occupation on a productive basis for almost every man.



Marksmanship Badges Manufactured by the Equipment Section, Rock Island Arsenal

Aside from the Ordnance work being performed by this Section, and it is to this work I shall endeavor principally to adhere, we have recently been or are now engaged in the production of supplies for the Air Service, Quartermaster Department and Department of the Interior, as well as work of a minor character. It is due to this activity, much of

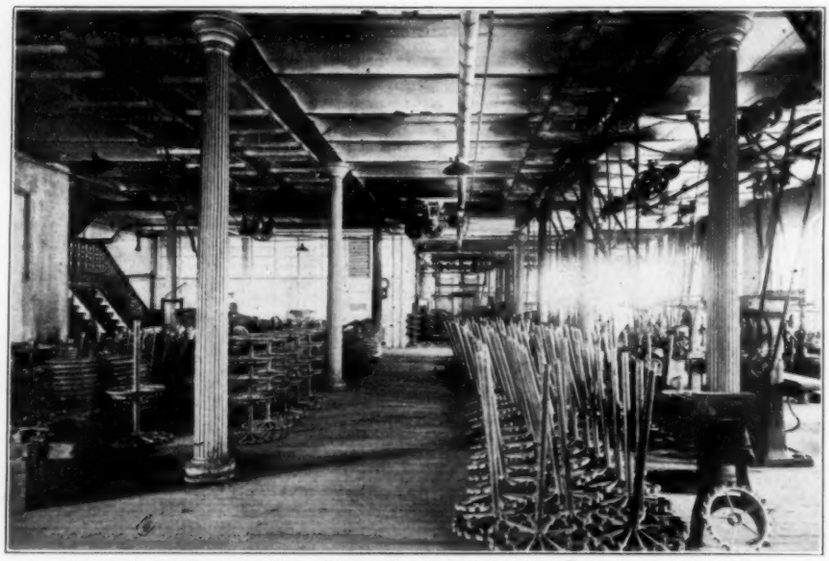


Spot Welding Fin Assembly for 1,000-lb. Demolition Bomb, Equipment Section, Rock Island Arsenal

which was obtained through competitive bidding, that we have been enabled to retain our organization and are to-day prepared, if called upon, to assume our place with other sections in supplying ordnance matériel.

We are now engaged in work for the Ordnance Department, consisting mainly in the production of arm racks for the Model of 1903 Rifle, Cal. .30, automatic pistol, Cal. .45, automatic revolver and for the Browning automatic rifle; also target spotter disks and pasteboard targets, as well as metal work for the sliding and bobbing targets. We are about to begin the manufacture of one thousand (1,000) cartridge storage cases for the 155-mm. gun and are prepared, if requested, to immediately produce in quantities, cartridge storage cases for either the 6-, 8-, 10-, 12-, 14- or 16-inch guns. Our machinery and tools are at hand, ready for immediate utilization, should the call be for bayonet scabbards, saber scabbards, bolo scabbards, chest metal work of a large variety, shoulder guards for 11.875-inch ball mounts for tanks, adjustable shoulder rests for Browning tank machine guns, hardware for ammunition chests, exhaust manifold guards for Liberty motors, gasoline tanks for various motor driven vehicles, Aiken targets, marking disks, tin containers for 75-mm. ammunition, oil cans, strap fasteners and many other items of an accessory nature.

Attention is respectfully called to three departments, which are of an especial auxiliary nature, owing to the fact that they are of considerable value to other sections at the Arsenal, as well as to the Equipment Section of which they are a part.



Assemblying Floor for Arm Racks, Equipment Section, Rock Island Arsenal

The Sheet metal Working Department. Equipped with practically all of the modern tools and machines that a craftsman could desire, this department, while reduced in personnel, can at once become operative on a much larger scale and prove a vital factor in construction and repair work necessitated through the adoption of the motor propelled vehicle of to-day.

Grinding, Polishing and Sandblasting Department. Four individual motor driven polishing lathes, two sandblast machines and a number of grinding and belt polishing machines, complete with accessories and all connected with an exhaust system excelled by none in this vicinity or elsewhere, constitute the principal equipment of this department. Through the transference of much of the work formerly done by the Equipment Section to the Quartermaster Department at Jeffersonville, Ind., probably no department in this section was so adversely affected as our polishing room. Work of a more modern and less transitory character has since been gradually finding its way here from all manufacturing sections at the Arsenal.

Plating Department. The building which houses this department was built for the purpose of meeting requirements which at that time were many thousands of pieces each day. Facilities were installed which proved adequate for the purpose. While in recent years work here has been somewhat of an intermittent nature, our experience has proved that most—if not all—branches of the Service find a plating establishment an indispensable adjunct. Our plating room stands prepared to do hot tin plating, zinc plating, parkerizing, black or white nickel plating, copper plating, silver plating or gold plating.

New 75-mm. Mortar

THE Ordnance Department announces that the Infantry will be equipped in the future with a new accompanying gun—a 75-mm. mortar. This weapon has passed severe tests at Fort Benning, and will be subjected to another complete test as soon as certain modifications have been made. This weapon will not be manufactured and issued for field trials until this second test is completed.

The weapon has the plunging fire of the mortar, but far more accuracy than the Stokes mortar, and is the result of six years of effort to produce such a gun. It fires a 12-pound projectile and has a range from 600 to 1,800 yards. It has telescopic sights and is very accurate up to its greatest range of 1,800 yards. This weapon will replace the Stokes mortar of the World War.

The 75-mm. mortar is light enough to be drawn by one mule or four men. Its various weights follow: Weight of mortar, 92 pounds; weight of cradle, trail, wheels, axle, etc., 280 pounds; weight of caisson and limber, 300 pounds.

In addition, the Department is also concentrating upon the perfecting of a 37-mm. gun and carriage. The model being developed at present will have the following weights: Gun, 82 pounds; cradle, trail, wheels, axle, 279 pounds; caisson and limber, 300 pounds; propellant charge, 1,300 grains smokeless powder; projectile, 1 pound 4 ounces.

Both weapons are for use against machine gun emplacements, strong points and entrenchments. The 37-mm. has a very flat trajectory and small dispersion. The new 75-mm. mortar will have a high angle, plunging fire and a wide dispersion.

The New York Advisory Board

By

HON. ELBERT H. GARY
Chairman, Advisory Board, New York Ordnance District

THE American people love peace and abhor war. That we do not want war is no guarantee we shall not have to fight again. To promote peace, and to enable us to wage a war of defense, quickly, vigorously, victoriously, in the shortest possible time and with the minimum loss of life and wealth, if and when forced into it by aggression, a great majority of our citizens advocate thorough preparation.

Hon. Elbert H. Gary

Combat, to-day, is not of armies alone, but of whole nations. Finance, manufacture, agriculture, transportation, all play their part in victory just as much as do troops, even though their share of the work may be less spectacular. The men behind the lines are the producing end of the great business of war; the men in the trenches utilize the products. All the various departments in war should work together and harmonize their efforts in time of peace. Not only our army, but our economic resources must constantly be ready for the call of mobilization.

It has been estimated that our unpreparedness, our smug complacence in our own strength and safety, our belief that we could "tread forever down the merciless old verities" cost us in the last war not only billions of dollars, but, what was far more serious, thousands of our best and bravest lives. We prayerfully hope this will never happen again; yet it is our duty to take every step possible to prevent it. If war is forced upon us, we shall leap to the fray "fortright, accoutred, accepting," with every ounce of our national energy ready.

It is the duty, and should be the pleasure, of every American, be he banker, producer, manager, clerk or laborer, to do everything practicable to strengthen the nation's fighting arm; to insure that our army shall be the best equipped as well as the best in personnel and training, and also the bravest; so that when the soldier goes into battle and offers his life for the safety of all who are unable to fight, he will know that we are supporting him, not only heartily and willingly, but efficiently.

The acceptance of service on the New York Advisory Board is a pledge of support by the representatives of leading industries. These men, believing in preparedness, are ready to cooperate wholeheartedly with the government in its plans to carefully, wisely and economically safeguard the nation.

Short biographical sketches of members of the New York Board appear on the following pages.

Hon. Elbert H. Gary

HON. ELBERT HENRY GARY, LL. D., Sc. D., was born near Wheaton, Ill., on his father's farm October 8, 1846. He was educated in the public schools of Wheaton and at Wheaton College, and was graduated from the law school of Chicago University, with the degree of LL. B., in 1867. He married in Aurora, Ill., 1869, Julia Emily Graves, who died June 21, 1902. On December 2, 1905, he married Mrs. Emma (Townsend) Scott. Admitted to the Illinois Bar in 1867, and to the Bar of the United States Supreme Court in 1882, Judge Gary was for several years Chief Deputy Clerk of the Superior Court of Cook County, Ill. Later he engaged in the practice of his profession in Chicago. He became one of the leaders of the bar and served as President of the Chicago Bar Association, 1893-4.

He was President of the town of Wheaton three terms, and when it was reorganized as a city he was the first Mayor and served two terms. He was for many years President of the Board of Education of his native city. He was County Judge of Du Page County two terms (eight years). He was called upon to hold court in Chicago for a considerable period of his entire service as Judge, and presided over a number of important cases in other counties throughout the state. At the time of his retirement from the bar in 1898, he was general counsel for several railroads and industrial corporations, and besides had a large general practice.

He had charge of the legal work connected with the organization of the Consolidated Steel & Wire Company in 1892, and of the American Steel and Wire Company in 1898. He took a leading part in the organization of the Federal Steel Company in 1898. Most of the work, legal and otherwise, was done by him, and, upon the completion of the organization, he was elected President. He then retired from the practice of law and moved from Chicago to New York. He also took a leading part in the organization of the United States Steel Corporation in 1901. He is Chairman of the Board of Directors and Chairman of the Finance Committee, and the "Chief Executive Officer of the Corporation in general charge of its affairs."

Judge Gary suggested and took a prominent part in the organization, in 1909, of the American Iron and Steel Institute. He is, and from the beginning has been, president of the same. He is a member of the Society of Colonial Wars, the Sons of the American Revolution, and of many leading social clubs of New York and Chicago.

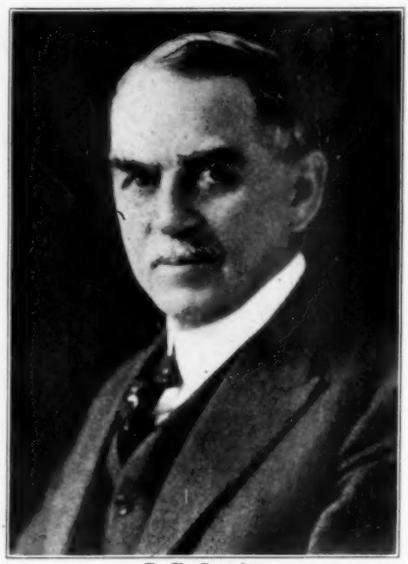
He is an art connoisseur and has been a collector of art treasures. His benefactions include the Gary Memorial Methodist Episcopal Church, in Wheaton, erected as a tribute to the memory of his parents, the Young Men's Christian Association building in Gary, Ind., and the Elbert H. Gary Library of Law, Northwestern University, Chicago.

Judge Gary was active in the location and in the building, for the United States Steel Corporation, of a steel plant in Indiana and also of a city at that point which was named for him. This steel plant is one of the finest and largest, and the city is already large and growing rapidly.

Judge Gary's ability as a lawyer, financier, man-of-affairs, public speaker and writer has been recognized by various academic honors, as follows: McKendree College, LL. D., 1906; University of Pittsburgh, Sc. D. 1915; Lafayette College, LL. D., 1915. On January 25, 1918, His Majesty, the Emperor of Japan, decorated Judge Gary with the Second Class Order of the Sacred Treasure for his valuable services in promoting a better understanding between Japan and America.—(*Extracts from "Gary Genealogy" by Lawrence Brainerd. Published by T. R. Mervin and Son, Boston,* 1918.)

Patrick E. Crowley

PATRICK E. CROWLEY, recently elected president of of the New York Central Lines, was born in Cattaraugus, New York, in 1864. He entered railway service at the age of 14 as a messenger at $5.00 per month. At 18 he was appointed station agent for the Erie at Custer City, Pa. From here he was transferred to the dispatcher's office at Buffalo.



P. E. Crowley

Mr. Crowley left the Erie to become track dispatcher for the Rome, Watertown and Ogdensburg Railroad, which was soon leased by the New York Central. Mr. Crowley rose steadily after entering the employ of the New York Central. In 1901 he became superintendent of the Pennsylvania Division, and three years later assistant general superintendent. In 1907 he went to Albany as assistant general manager, and, five years later, became general manager for lines east of New York. In December, 1914, Mr. Crowley became assistant vice-president in charge of operation, and in 1916, vice-president. During the World War he left this position to act as Federal Manager for the New York Central and several other roads of the New York Central System. At the end of Federal control he resumed his position as vice-president which he held until his election to the presidency of the road, in April, 1924, succeeding A. H. Smith.

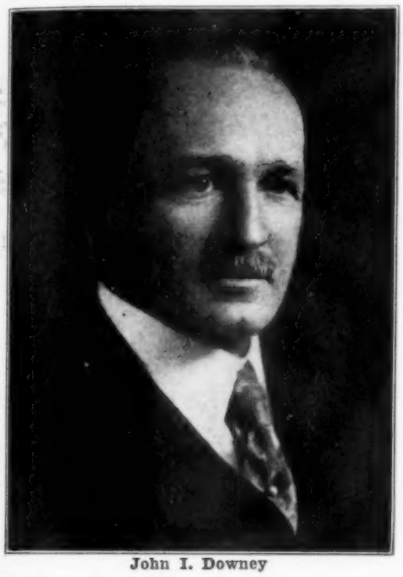
Mr. Crowley married Caroline Nichols of Attica, N. Y., in 1891. His home is in Mt. Vernon, New York. He is a member of the Transportation and New York Press Clubs.

John Irving Downey

JOHN IRVING DOWNEY was born in New York City on July 8, 1876. He was graduated from St. Paul's School, Concord, New Hampshire, in 1894, and received his Ph. B. from the Sheffield Scientific School, Yale University, in 1897. He is the president of John I. Downey, Inc., a firm engaged in building construction.

During the World War, Mr. Downey was chairman of

the Wood Workers Committee in four Liberty Loan Campaigns, chairman of the Building Trades Committee in the second Red Cross Drive, and in 1918 he served in Washington as executive secretary of the Facilities Division of the War Industries Board.



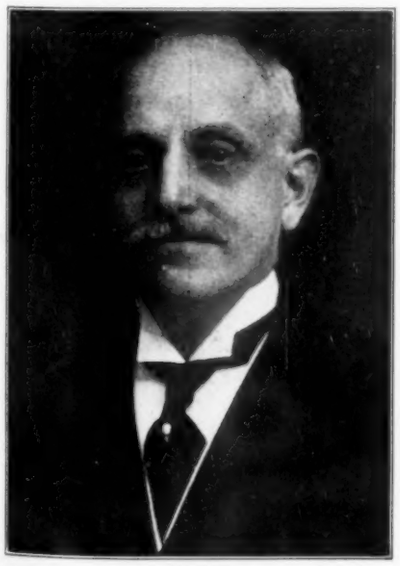
John I. Downey

He is a director of the Bankers Trust Company and of the Fifth Avenue Bank, and vice-president and trustee of the Franklin Savings Bank. He is a member of the Union League, Yale, University, Blind Brook Golf, Apawamis, and Manursing Island Clubs, the Down Town Association, the Sons of the Colonial Wars, Metropolitan Museum of Art, American Museum of Natural History, New York Zoological Society, Chamber of Commerce, State of New York, and the Merchants Association of New York.

Michael Friedsam

COL. MICHAEL FRIEDSAM was born in New York City. He was educated in the public schools of New York and in the Weston Military Academy at Weston, Connecticut.

Since the completion of his schooling he has been connected with B. Altman & Company, of which organization he is now president. He is likewise president of Altman Foundation, director of the Fifth Avenue Association, Merchants' Association, the Bankers Trust Company, the Bank of the Manhattan Company, Franklin Savings Bank, and others.



Michael Friedsam

He is a member of the New York State Industrial Council, the Architectural League of America, and the Chamber of Commerce of the State of New York. He belongs to the following clubs: Lotos, Friars, Harmonie, City Athletic, North Shore Country, Army and Navy, Uptown, National Republican, Advertising, and others.

During the War Colonel Friedsam served as Quartermaster General of the New York State Guard. He was the New York State merchant representative of the Federal Food Administration and is also connected with many charitable and benevolent institutions of New York City, and many pertaining to civic affairs of the city and state.

Colonel Friedsam was recently made a Chevalier of the Legion of Honor by the French Government in recognition of his interest in French art, and for various services rendered to the French Government.

S. Parker Gilbert

S. PARKER GILBERT was born in Bloomfield, New Jersey, in October, 1892, the son of Seymour Parker and Carrie Jennings (Cooper) Gilbert. After graduation from the high school in Bloomfield, he entered Rutgers College, from which he was graduated in 1912. Three years later, he received his LL.B. *cum laude* from the Harvard Law School.

S. Parker Gilbert, Jr.

After receiving his law degree, Mr. Gilbert entered the offices of Cravath and Henderson, in New York City, where he worked for three years. Then he went to Washington. He made vain attempts to enlist in Army service, but a wound which had refused to heal following a surgical operation kept him from success here. So Mr. Gilbert, instead, became a member of the War Loan Staff in the office of the Secretary of the Treasury. He served the Treasury Department under Secretaries McAdoo, Glass, Houston and Mellon. In June, 1920, he was made Assistant Secretary, and, in July, 1921, he became Under Secretary of the Treasury. In November, 1923, Mr. Gilbert left Washington to resume his law practice in New York City. Then came the appointment which has taken him to Berlin to assume his duties as Agent General for Reparations under the Dawes plan.

Mr. Gilbert is a member of the Metropolitan and Chevy Chase Clubs in Washington, and of the University, Harvard, Harvard Law, City Midday and India House Clubs in New York City.

James G. Harbord

J. G. HARBORD, president of the Radio Corporation of America, was born at Bloomington, Illinois, in 1866. He attended the public schools there and in Lyon County, Kansas, and was graduated from the Kansas State Agricultural College in 1886. He taught at the college from which he was graduated until 1889, when he enlisted in Company A, 4th Infantry. He married Emma Yeatman Ovenshine of Washington, D. C., in 1899.

James G. Harbord

General Harbord saw Army service until his retirement in December, 1922, to become president of the Radio Corporation of America. He was in Cuba in 1901 and in the Philippines from 1902 to 1914, where he was Chief of the Moro Constabulary and of Southern and Central Luzon, and acted as Chief of the Philippine Constabulary, terminating service with the Philippine Government under the operation of the "Manchu Law" on January 1, 1914.

During the World War General Harbord was Chief of Staff, A. E. F., from May, 1917, to May, 1918. He was then assigned to a marine brigade and commanded it near Chateau Thierry. He commanded the Second Division, National Army, during the Soissons offensive, and then was assigned to command the Services of Supply where he served until May, 1919, when he was reappointed Chief of Staff. In August of that year, he relinquished this post to go to the Near East as Chief of the American Military Mission to Armenia. After his return to this country, he went to Camp Travis, in command of the Second Division.

General Harbord has received the following decorations: Distinguished Service Medal, U. S. Army; Distinguished Service Medal, U. S. Navy; Knight Commander, St. Michael and St. George, Great Britain; Commander, Legion of Honor, France; Grand Officer, Order of the Crown of Belgium; Commander, Order of St. Maurice and St. Lazarus, Italy; Grand Officer, Prince Danilo, Montenegro, and La Solidaridad, Panama.

Herbert P. Howell

H. P. HOWELL was born, 1873, in Western Pennsylvania. He attended a country school until thirteen years of age.

From 1901 to 1913, Mr. Howell was credit manager of the Carnegie Steel Company in Pittsburgh. From 1913 to 1922 he was vice-president of the National Bank of Commerce in New York City. He is now managing director of Peierls, Buhler & Co., Inc., factors and commission merchants in New York City.

Mr. Howell is a director of the Bankers Trust Company of New York, the Equitable Life Assurance Society of United States, the Merchants Protective Association, and Wells, Potter, Fish and Ustick, Inc. He is a member of the Advisory Board, New York Ordnance District; of the Examining Committee of the Bankers Trust Company; of the Finance Committee, Equitable Life Assurance Society; of the Membership Committee of the Union League Club; of the Committee of 1000—New York Subways; and Chariman of the Committee on Bankruptcy of the Merchants Protective Association.

Herbert P. Howell

He is also a member of the Japan Society, Knollwood Country Club, White Plains, N. Y., Manhattan, Metropolitan, Pennsylvania Society, and Union League Clubs of New York; the Wianno Club, Wianno, Mass.; the Duquesne Club, Pittsburgh, Pa.; the Bankers Club of America, and the Cherry Valley Club, Garden City, L. I.

Samuel McRoberts

SAMUEL McROBERTS was born in Malta Bend, Mo., December 20, 1868. After several years' attendance in the public schools of Malta Bend, Mr. McRoberts entered Baker University, Baldwin, Kansas, from which he was graduated in 1891. He then began the study of law at the University of Michigan, graduating in 1893. He holds the degrees of A. B., A. M. and LL. D. from Baker University and an LL. B. from Michigan. On leaving college, General McRoberts became connected with the legal department of Armour & Company, and, in 1904, he was elected treasurer. This association was continued up until 1909, when he came to the National City Bank as its vice-president and member of the board of five executive managers, which handled practically all of the operating

Samuel McRoberts

problems of the bank. He was commissioned a major in the Ordnance Reserve Corps, November, 1917, and promoted to colonel in the National Army shortly afterward. In December, 1917, he became chief of the Procurement Division, Ordnance Department, with direction of the contracting of all ordnance matériel which the Army used.

On August 28, 1918, he was named Brigadier-General and transferred to the A. E. F., thence, until his discharge, he was actively engaged either in providing supplies for the fighting army, or in disposing of supplies after the Armistice was signed.

General McRoberts is on the Board of Directors of the following companies: American Sugar Refining Company, The Consolidation Coal Company, American Ice Company, National Surety Company, Kansas City Southern Railway Company, Great American Insurance Company, American-Alliance Insurance Company, Freeport Texas Company, the Rail Joint Company, the Rossia Insurance Company and other corporations. He is also a trustee of Baker Universtiy, Northwestern University and the Young Men's Christian Association of New York.

Charles M. Schwab

CHARLES M. SCHWAB was born at Williamsburg, Pennsylvania, in 1862. When a small boy, his family moved to Loretto and he received his education in the public schools there and at St. Francis College. He married Miss Emma Dinkey in 1883.

Charles M. Schwab

His earliest job was that of driving a coach from Loretto to Cresson, but he soon left this to go to Braddock, where he found work in a grocery store. His first connection with the steel business was as a stake driver for the engineering corps of the Edgar Thomson Steel Works. Thereafter, his rise was phenomenal. He had a genius for organization and administrative tact that produced results and won recognition for him. At the age of thirty-five, he was president of one of the greatest manufacturing corporations in America.

During the war, Mr. Schwab was Director General of the Emergency Fleet Corporation.

Some of the offices Mr. Schwab now holds are: Chairman of the Board of Directors of the Bethlehem Steel Corporation, the Bethlehem Steel Company, and the Chicago Pneumatic Tool Company; director of Loew's Inc.; Bethlehem Spark Plug Company, Metropolitan Life Insurance Company, Stutz Motor Car Company, American Motor Body Company, Empire Trust Company, Empire Safe Deposit Company, Chicago Pneumatic Tool Company, Tonopah Extension Mining Company, United Zinc Smelting Company, Vanadium Corporation and the Chase National Bank.

Guy E. Tripp

GUY EASTMAN TRIPP was born in Wells, Maine, on April 22, 1865, and was educated at South Berwick (Maine) Academy. He was commissioned Colonel in the Ordnance Department on January 16, 1918, and, in recognition of his excellent work as head of the Production Division, was appointed Brigadier-General in the Ordnance Department, U. S. A., on August 23, 1918, on which date he was relieved from duty as head of the Production Division and assigned to duty as Special Asistant to the Chief of Ordnance, in charge of District Ordnance Offices.

Guy E. Tripp

The establishment of Ordnance Districts for the production of war material, with a view to decentralization of authority relating to matters of administration, production, inspection and shipment of supplies, was inaugurated by General Tripp during his tenure of office as Chief of the Production Division, and later played such an important part in Ordnance activities as to justify the assignment of a Special Assistant to handle matters pertaining thereto. This latter position General Tripp occupied until after the Armistice had been signed, when he returned to civil life as Chairman of the Board of Directors of the Westinghouse Electric & Manufacturing Company.

General Tripp is a director of the following corporations: American International Corporation, American Surety Company, American Water Works and Electric Company, Bryant Electric Company, Canadian Krantz Electrical and Manufacturing Company, Ltd., Canadian Westinghouse Company, Ltd., Chase National Bank, Interborough Consolidated Corporation, Interborough Rapid Transit Company, Krantz Manufacturing Company, Martin-Parry Corporation, Morris Plan Company of New York, New England Westinghouse Company, R. D. Nuttall Company, One Hundred and Forty-fifth Street Crosstown Railroad Company, Pennsylvania Electric Company, Pittsburgh Meter Company, Wabash Railway Company, Westinghouse Electric International Company, Westinghouse Gear & Dynamometer Company, Westinghouse Lamp Company, Westinghouse Metall-faden Glühlampenfabrik Gesellschaft m. b. H. of Vienna, Westinghouse Metal-Filament Lamp Co., Ltd., of London, West Penn Power Company, West Penn Railways Co., West Penn Traction & Water Power Company.

James L. Walsh

JAMES L. WALSH, Chief of the New York Ordnance District and former Secretary of the Army Ordnance Association, was born in Massachusetts May 6, 1885. A graduate of the United States Military Academy, Class of 1905, he served in various executive capacities in the Ordnance Department of the Army, and, during the World War, was executive assistant to the Chief of Ordnance.

James L. Walsh

For his conspicuous war service, Colonel Walsh was awarded the Distinguished Service Medal "for exceptionally meritorious and distinguished services in a position of great responsibility, first as chief of the Personnel Division, Office of the Chief of Ordnance, which he organized and administered with conspicuous success during the first nine months of the war, a critical period, during which all Ordnance activities depended upon the successful handling of the personnel problem, and, later, as personal and executive assistant to the Chief of Ordnance, in which capacity his breadth of vision, tact, sound judgment and loyalty were invaluable to the Government in the numerous highly confidential matters entrusted to his care."

In 1919, he assisted in the organization, and became first permanent secretary, of the Army Ordnance Association.

Upon his resignation from the Army in 1922, Colonel Walsh took up his present association with the Bankers Trust Company of New York. In 1923, he was appointed Chief of the New York Ordnance District.

William H. Woodin

WILLIAM H. WOODIN, President of the American Car and Foundry Company, was born at Berwick, Pennsylvania, in 1868, the son of Clemuel Ricketts and Mary Louise Dickerman Woodin. He was educated in the public schools of Berwick, Woodbridge School, in New York, and the School of Mines of Columbia University. He married Miss Annie Jessup on October 9, 1889.

Mr. Woodin's early experience was with the Jackson and Woodin Manufacturing Company in Berwick. In 1889, he entered the employ of the American Car and Foundry Company as its district superintendent in Berwick. He then served as assistant to the first vice-president, and, later, as assistant to the president of the company. In 1916, he became president of the company. He is also a member of the executive committee and a director of the company.

Mr. Woodin is a member of the Executive Committee and a director of the American Locomotive Company; chairman of the Executive Committee and director of the Canadian Car and Foundry Company; director of the Montreal Locomotive Works; member of the Executive Committee and director of the American Exchange Securities Corporation, and a director of the General Motors Corporation.

William H. Woodin

He is a member of the Railroad Club of New York, the Union League, Metropolitan, Lawyers, Union, Union League of Philadelphia, Oakland Golf, Racquet and Tennis and India House Clubs, and is a resident of New York City.

Clarence E. Davies

Secretary

CLARENCE E. DAVIES was born in Utica, N. Y., March 15, 1891. He was educated in the public schools of Utica and at Renselaer Polytechnic Institute, from which he was graduated in 1914, with the degree of M. E. He entered the employ of the Smith Premier Works of the Remington Typewriter Company at Syracuse, N. Y., and served in various engineering and production capacities until September, 1917, when he was commissioned in the Ordnance Department and assigned to Frankford Arsenal. There he served in the Artillery Ammunition Division, acting as superintendent of the fuze shop from January, 1918, to January, 1919, when he left the service with the rank of captain.

Clarence E. Davies, Secretary

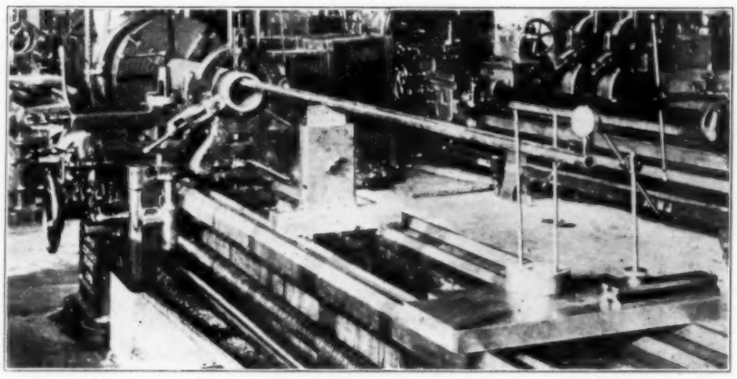
In March, 1920, he became Associate Editor of *Mechanical Engineering*, the journal of the American Society of Mechanical Engineers, later being advanced to the position he now holds, that of Assistant Secretary and Managing Editor of the publications of the Society.

Floor Inspection of Artillery at Rock Island Arsenal

By

A. C. FORREST

FLOOR inspection of artillery matériel in its present form was first introduced into Rock Island Arsenal during the early part of 1903 when the 3-inch field matériel, Model of 1902, had been finally adopted as the standard piece of the Army. This was one of the first really successful long recoil carriages made in this country, and in its design were embodied many complex machining and inspection problems. These difficult problems had to be worked out by the foreman and the machinist on the job, as there were no planning rooms or engineering departments established at that time. Thus were developed many competent men, who, as the business increased, filled responsible positions in the Arsenal and in the manufacturing industries of the surrounding cities.



"Tell-Tale" as used at Rock Island Arsenal in Boring and Turning Recoil Cylinder

Of all the components the most difficult to manufacture was the recoil cylinder. Unfortunately for the Arsenal, the design called for a piece of steel tubing finished outside and inside. Each time a cut was taken, either on the outside or on the inside, the cylinder would run out of true and it was only by taking infinitesimal cuts that the work was finally accomplished. During these troubles, incident to boring and turning the cylinder, the use of a "tell-tale" came into play; fortunately the inspector on the job had worked at Watervliet Arsenal, where the tell-tale has been extensively used in the manufacture of guns, and thus had a knowledge of the correct instrument required to prove if the inside of the long hole, all the way through, was concentric with the outside.

Lately, in going over some of the work done during the World War, it was a surprise to discover that the use of a tell-tale in truing-up the outside with the inside, of a piece of work, was not universally understood. A great many piston rods received here after the war had the counter-recoil buffer hole so eccentric that the buffer hole nearly came through the side of the piston rod.

After our boring and turning problem, came the question of how to cut the throttling bars in this same cylinder. In the previous carriages, manufactured at this Arsenal, throttling bars, 5 or 10 inches long, were made and inserted in the cylinder. The problem now was—how to machine a throttling bar 45.5 inches long, the same to be an integral part of the cylinder. This problem opened up a large mechanical field of invention, not only for the shop, but also for the floor inspection. The tools finally designed to do the work apparently did their work well, but it was up to the inspector to prove that such was the case. At this stage of the game, the star-gage was introduced to measure the shape of the bars, and it was discovered that the inspector's measurements and the measurements the machinist was working for were altogether different. After considerable investigation, it was discovered that both the inspector and the machinist were wrong. The standard star-gage points were too wide and when working on the curved surface, instead of the center of the point being on the line of measurement, the side of the point was hitting on the side of the curve, consequently giving a minus reading. The machinist's error was in not having the cutting edge of his tool in a direct line with the center of the cylinder.

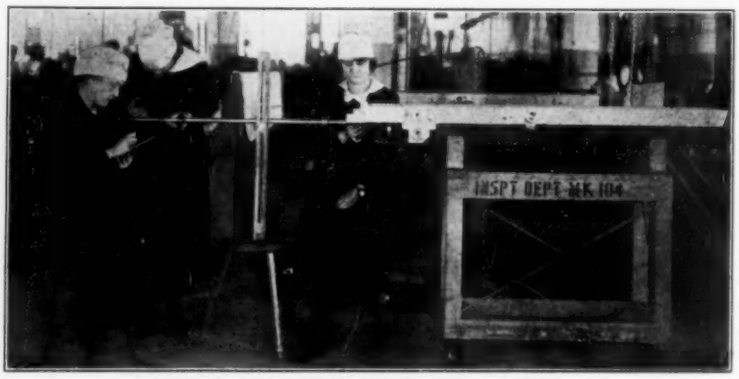
These incidents show the evolution of the function of the floor inspector, originally a function taken care of by the foreman. It has now become a very important part of the shop administration.

The eventual solving of these difficult mechanical problems speaks well for the officers and men engaged in this work. That they were real problems is attested by the fact that the *Rheinische Metallwaaren und Maschinenfabrick*, of Dusseldorf, Germany, considered at that date one of the leading ordnance manufacturers of Europe had difficulty in overcoming these very problems. This firm had received an order to manufacture fifty carriages and, on the whole, did very creditable work; but when it came to the cylinder, this Arsenal had to furnish them with a complete set of drawings showing all the tools used in the manufacture and inspection.

The same evolution is now taking place at this Arsenal. Inspectors who have worked for years on horse-drawn gun carriages are now educating themselves to take care of the inspection of motor-drawn vehicles of all kinds. Then, there are the hydro-pneumatic recoil systems with their complicated assemblies and innumerable tests. All these new additions to the matériel of the Ordnance De-

partment demands that skilled inspectors should be in the making at all times, so that in case of emergency they can be sent out to instruct others in the fine points of artillery inspection.

Inspection is perhaps the one operation in the process of production which should not be speeded, without the most careful consideration of consequences. In too many cases, lax inspection has allowed components to pass to the assembly department with grave results. Being forced to fit a piece by hand to make it assemble correctly is not economical. It is not advisable to hasten a man in the use of delicate instruments which are made to catch small variations in a manufactured part and such speeding will invariably result in imperfect inspection. Better results can be obtained by the selection of honest, capable men, who give no suspicion of trifling and who can use their heads when the question of rejection or acceptance of a valuable piece is at issue. A slight deviation from the allowed tolerance should not always reject a piece of work.



Using the Star Gage at Rock Island Arsenal

The floor inspection of artillery material at Rock Island Arsenal, which, previous to the late war, covered mostly horse-drawn vehicles, now includes all styles of motor-drawn vehicles such as tanks, tractors, trailers, repair trucks, motor carriages, etc., together with newly adopted hydro-pneumatic recoil systems. From the above list of articles, it will be seen that it is necessary to have a number of high-class men on the job, not only able to do the actual inspection, but endowed with enough mechanical ingenuity to help the assembly department thrash out the causes for interference, check errors in the drawings, etc.

A floor inspector should be a graduate from the manufacturing department, who comes to his new position well versed in shop procedure. This knowledge of procedure is very necessary for the inspector, as he has to assure himself that the components as they pass through the different operations are having the proper heat treatment, etc., called for on the shop order. At the same time, it is essential to determine whether the piece still conforms with the latest drawing. This can be accomplished readily by checking the revision date shown on the drawing accompanying the work, with the latest Foreman's Bulletin, issued by the Drafting Room, which shows the latest revision of all work going through the shops.

The system of inspection carried out at Rock Island Arsenal is very simple. When the work starts through the shops, there is attached to each job a route tag, and a blue print of the part. At the same time there is issued to the inspector a copy of the shop order, in duplicate. Upon completion of the work of inspection one of the shop orders is returned to the planning room, signed by the inspector and giving date of completion, the other copy remains in the inspection files for future reference. The route tag goes with the work and remains with the work until it is assembled in the vehicle.

After each operation, as the material is inspected, the shop order is taken from the files and notations made thereon, as to the number of pieces accepted and number rejected. In cases where the pieces are not spoiled so badly but that they can be salvaged, a salvage report is made out and sent to the planning room. This report gives a full history of the causes for salvaging and suggests certain methods for saving the work.

In case of rejection, a similar report is made out, but the rejected pieces are set aside in a convenient place in the inspection room, where they can be looked over by the shop superintendent and the officer in charge of the shop. If they agree that the work cannot be used for the purpose intended, it is turned over to the salvage department for disposition.

This procedure is continued until the piece is finished and ready for final assembly.

The fact that the route tag and blue print are always attached to the work makes it very convenient for the inspector while on his trips from one machine to another. By a glance at the route tag, he can always tell the last operation inspected so that when he is called upon to make an inspection it will not be necessary for him to inspect the piece all over again, but only such operations as have not previously been inspected. Also the fact that the drawing has been issued from the shop planning room, where a regular system of check on drawings is kept, further assures him that the work is being done in accordance with the latest drawing.

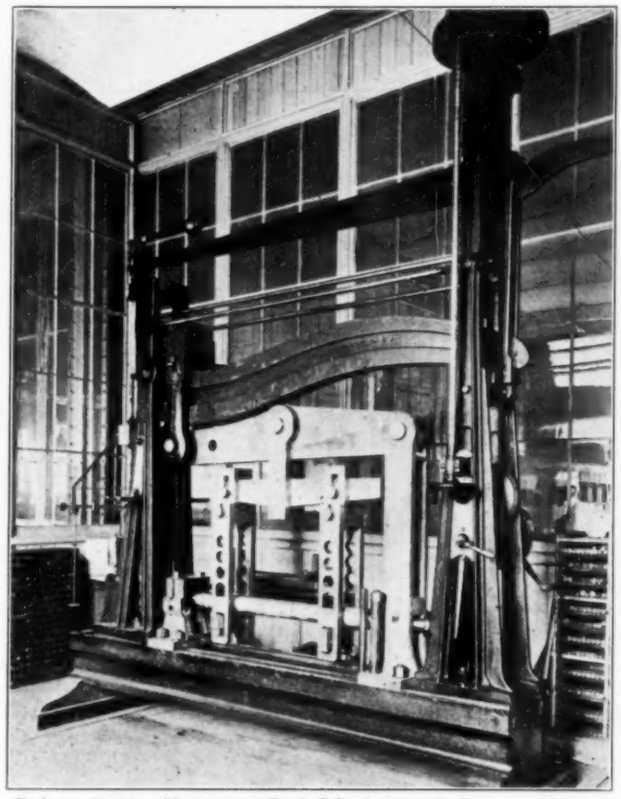
In cases of mass production inspection, it was found very convenient to have four-wheeled trucks about the height of the average bench with a flat two-foot square top, upon which a complete unit of inspection tools was arranged. The different components of each inspection unit under manufacture in any particular part of the shop could be taken care of with ease. All the inspector had to do was push his truck with the inspection tools upon it from machine to machine. This system saved the machinist running to the inspection room when he had work ready for inspection; hence, a great saving in production time was made.

Under normal conditions of manufacture it has been found that departmental inspection is the best. That is, after each operation the work is taken to a crib, where a one hundred per cent inspection is given. This precludes the possibility of spoiled work going through further machining operations.

A great many manufacturing establishments have instituted a plan whereby each foreman is charged with the scrap which emanates from his department and is told monthly of the money value of this scrap. This plan cuts down the loss to a minimum. A somewhat similar method was tried out at this Arsenal with good results. The spoiled work was piled up in such a manner that the officer in charge and the general manager could

get a very good idea of just where the poor work was coming from. The moral effect was not as definite as had been intended. It did, however, reduce the amount of spoiled work.

A good floor inspector is an asset to any organization. A foreman in charge of production machines such as turret lathes, etc., generally has his hands full and can give very little detailed advice to his men. Here is where the good floor inspector comes in. If, during the "set-up," the men on the machines are having trouble getting a proper start, the inspector is on hand with his tools and gages helping to find just what the trouble is, and giving the necessary advice to help get things started. Getting high production machines started correctly is half the battle.



Rodman Testing Machine at Rock Island Arsenal. Power 4,000 to 1

At the present time the greater part of the work going through the shops is of an experimental nature. This necessitates the use of a great number of intricate gages and, accordingly, slows up inspection. Under quantity production, this condition would not obtain.

The floor inspector at an arsenal is governed by the rules and regulations laid down for the government of Ordnance inspectors at private establishments. Pamphlets, No. 51.0-1, "Instructions to Bidders," and No. 1793, "Inspector's Manual," contain a great deal of valuable information for an inspector and should be studied very carefully.

The general routine of the floor inspector is as follows:

Upon receipt of any material in store which will enter into the manufacture of any of the vehicles, a "call for inspection" is issued by the storekeeper to the inspection department. If the component is a casting, it is laid out carefully by the inspector to see whether it will machine correctly, and if found correct, the accompanying papers are signed accordingly and returned to the storehouse. If a physical test has not already been made at the place of manufacture, the regulation coupon attached to the piece will be forwarded to the testing laboratory accompanied by an "analytical order" made out by the inspector, giving all the necessary information, as to the kind of test required, etc.

After the testing laboratory has made the necessary tests, copies of the test report are forwarded to the inspection department and to the storehouse.

The storehouse having reports that the dimensions and physical qualities of the casting are correct, is now free to issue the castings, upon request from the shop.

Any component which during the process of manufacture calls for a test is handled in the same manner, the usual papers are made out and sent to the laboratory and upon completion of the test the inspector and the department interested are notified so that the material can be put through the remaining operations.

Another function of the floor inspector is to see that the fine measuring instruments used by the shops are kept up to standard. The rule is that every instrument, after being used by a workman in the shop, shall not be issued again until the inspector has checked the instrument to see that it is up to the standard.

If the parts are for a new type of vehicle each part is weighed and the data carefully recorded for future reference. All pull tests for piston rods, hydraulic tests of cylinders, bending test for axles, gymnastiquer and dynamometer tests for recuperators, have all to be made and it is the inspector's duty to see that they are carried out and the data entered on the inspection reports.

Another important function of the floor inspector during final assembly, is to see that in the case of interference, the interference is removed from the part which will assure of interchangeability; that is to say, it is better and proper to remove surplus stock from a casting rather than remove metal from a finished part.

Finally, after the vehicle has been assembled, the various maneuvering tests have to be made. In the case of the motor vehicle there is the block test, road test, and test for oil and gas consumption. For the gun carriage, the weight and time to elevate and depress the gun and the weight and time to traverse the gun to the right and left azimuth. The time is taken with a regulation stop-watch; the weight by suspending a pail from the rim of the handwheel and pouring in sand until the handwheel starts to move. The gun is then retracted to its full recoil at all elevations and depression, also at extreme azimuth to determine whether there are any interferences. At the same time, the gun is allowed to return into battery to see that the counter-recoil action is not too fast or too slow. The final test of the carriage is the setting of the sights; this is done according to regulations, as laid down in the handbooks. In type carriages and experimental proof tests of all kinds, the floor inspector at Rock Island Arsenal has the responsibility of seeing that all proving ground equipment is designed and attached to the vehicles. This equipment consists of a Tabor indicator to record the internal cylinder pressure, a Sebert velocimeter to record the velocity of recoil, a Rock Island Arsenal design of velocimeter to record the velocity of counter-recoil and pencils attached to the ends of the axle to register the amount of jump of the carriage.

The 33rd Ordnance Company

The 33rd Ordnance Company Rock Island Arsenal

By

GEO. W. OUTLAND

THE 33rd Ordnance Company (Heavy Maintenance) was organized April 11, 1921, by transferring the personnel of the Ordnance Detachment at Rock Island Arsenal to the Company. The original peace strength under which the company was organized called for two officers and one hundred and eighteen men. This number has been changed from time to time and the present allotment provides for two officers and one hundred and ten men in time of peace, the war strength being eleven officers and two hundred and ninety-four men, including one officer and six men of the Medical Department.

The company is quartered in the old stone barracks on East Avenue at Rock Island Arsenal. The quarters provide modern facilities, tub and shower baths, sanitary kitchen and large, well lighted dining rooms. Within the barracks are the Post Exchange owned exclusively by the company, a modern and up-to-date, well furnished library and a recreation room with musical instruments, pool tables, etc.

In the Welfare Building, near the barracks, are located the Bowling Alleys and pool and billiard tables, which belong to the Post Exchange. In the same building is a large ballroom suitable for dances, motion pictures and entertainments as well as basketball and other indoor games.

The company maintains a garden and some fine Holstein cattle, which materially benefit the mess, especially during the summer months.

At the present time the company is allotted one technical sergeant, one first sergeant, six sergeants, eight corporals, thirty-one privates, first class, and sixty-three privates.

The allowance for specialists' ratings are as follows: five first-class, twelve second-class, eight third-class, five fourth-class, nine fifth-class and seventeen sixth-class.

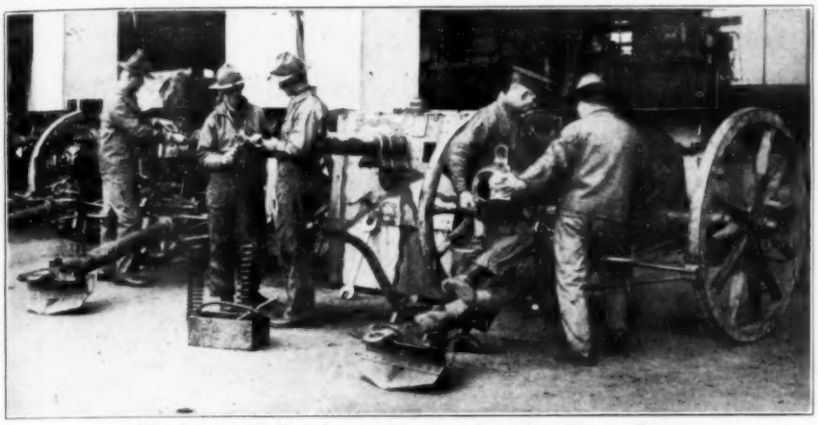
The company is divided into the following sections: Automotive, Artillery, Small Arms and Service. The Automotive Section is trained in the maintenance and repair of tractors, tanks, trucks, trailers, automobiles and motorcycles. The Artillery Section is schooled in the upkeep and repair of all artillery matériel handled at Rock Island Arsenal and available for instruction purposes. The Small Arms detail is capable of maintaining and repairing all small arms equipment such as rifles, pistols, revolvers, machine guns, automatic rifles, shot guns, etc. In the Service Section naturally are the machinists, welders and blacksmiths, saddlers, painters, carpenters, electricians, etc. To the Service Section falls the responsibility of such shop work as may be necessary in the repairs of any equipment in the production program of the other sections. Its members are schooled and adept in the use of such machines, tools, etc., as are a part of the field and garrison equipment of the organization.

Members of the 33rd Ordnance Company Overhauling Mark VIII Tank

Equipment

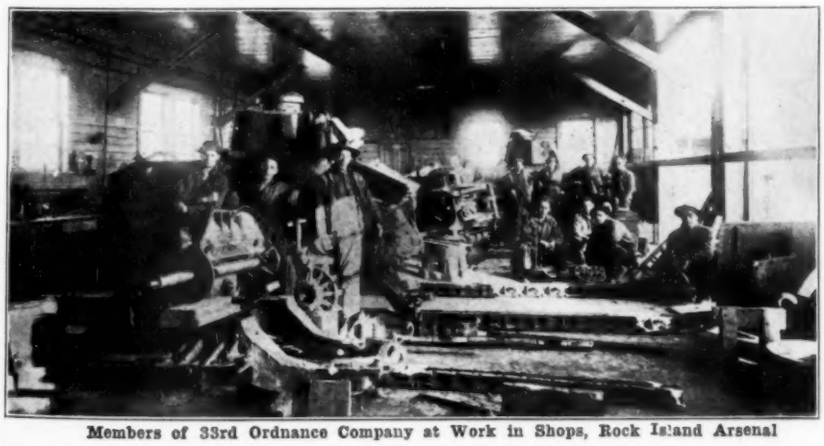
The company maintains a shop for use during the winter training months in which one each of the following tools and equip-

ment are permanently installed: Milling machine, 9-inch lathe, 20-inch lathe, grinder, shaper, hacksaw, saw rig, drill press, grindstone, direct current generator, blacksmith's forge and oil tank, also two emery wheels, two boiling tanks, four engine stands and other miscellaneous tools, etc. This equipment is loaned to the company by the Manufacturing Division of the Arsenal and is in addition to the regular field equipment of the company.



Members of 33rd Ordnance Company Repairing 75-mm. Gun

In one of the accompanying photographs is shown the organization with its equipment prepared to move into the field. The rolling stock of the company comprises the following list of vehicles: Nine Artillery Repair Trucks, two Dodge Light Repair Trucks, two Equipment Repair Trucks, one Baggage Truck, one Tool Room Truck, one Air Compressor Truck, one Power Saw Truck, one Office Truck, six Spare Parts Trucks; one Tank Truck, six Cargo 3-ton Trucks, three G. M. C. ¾-ton Delivery Trucks, five Parts and Stock Room Trailers, one Welding and Forge Trailer, one Baggage Trailer, one Bar Stock and Hacksaw Trailer, one Drill Press Trailer, one Lathe Trailer, one Generator Trailer, one Milling Machine Trailer, five Motorcycles, one Rolling Kitchen Trailer.



Members of 33rd Ordnance Company at Work in Shops, Rock Island Arsenal

The remaining vehicles pertaining to the peace time equipment of the company are in storage at Erie Proving Ground. The vehicles with the company are stored in buildings at the Arsenal. The trucks, tailers, etc., needed from time to time by the organization in its shop work are stored in a building connected with the shop.

Lists are kept showing the equipment which is a part of the various vehicles. Some of the tools are taken from the vehicles and stored in the tool room of the shop from which they are issued to the men of the various sections, from time to time, as they are required on various jobs.

Assignment

The company is stationed at Rock Island Arsenal. This location is ideal, being central with respect to the Fifth, Sixth, and Seventh Corps Areas, in which all the Ordnance personnel below Grade 3 are on detached service from the 33rd Ordnance Company. Assignment to this Arsenal also provides an opportunity for the company to utilize, in its production program, the equipment and organization of the Manufacturing Division.

During the summer training camps the company is required to distribute among the above corps areas approximately eighty enlisted men qualified to maintain and repair the equipment used in the various training camps. During the remainder of the year, thirty-seven men remain on detached service at various stations in those corps areas to handle the Ordnance activities.

The men stationed on detached service must, necessarily, be competent and qualified for the various duties incident to this service. They must first be trained in the company shops and specialized along some particular line of work.

In addition to the training obtained at Rock Island Arsenal, approximately five men are on detached service each year at the Ordnance Specialists' School, Raritan Arsenal, where they receive special training and instruction.

Duties

During peace time the company is required to furnish trained personnel to three Corps Areas to accomplish field and garrison repair to Ordnance equipment incidental to the training of line organizations. During the summer training camps only a sufficient number of men to handle the routine duties of the post are retained at Rock Island Arsenal.

Detachments are sent to the training camps, in some cases accompanied by an officer of the organization, in time to check the necessary Ordnance matèriel and have it prepared for issue at the opening of the training season. During the period of the camp they function to repair, replace, and provide all necessary Ordnance stores and equipment. At the close of camp all such stores and equipment are taken in, cleaned and properly packed for storage during the winter months.

At the close of the summer camps, men are picked according to their qualifications for detail at the various stations until the next training season. The remainder of the organization returns to Rock Island Arsenal. The company is then divided into groups or sections for the period of training in the company shops. From October until May,

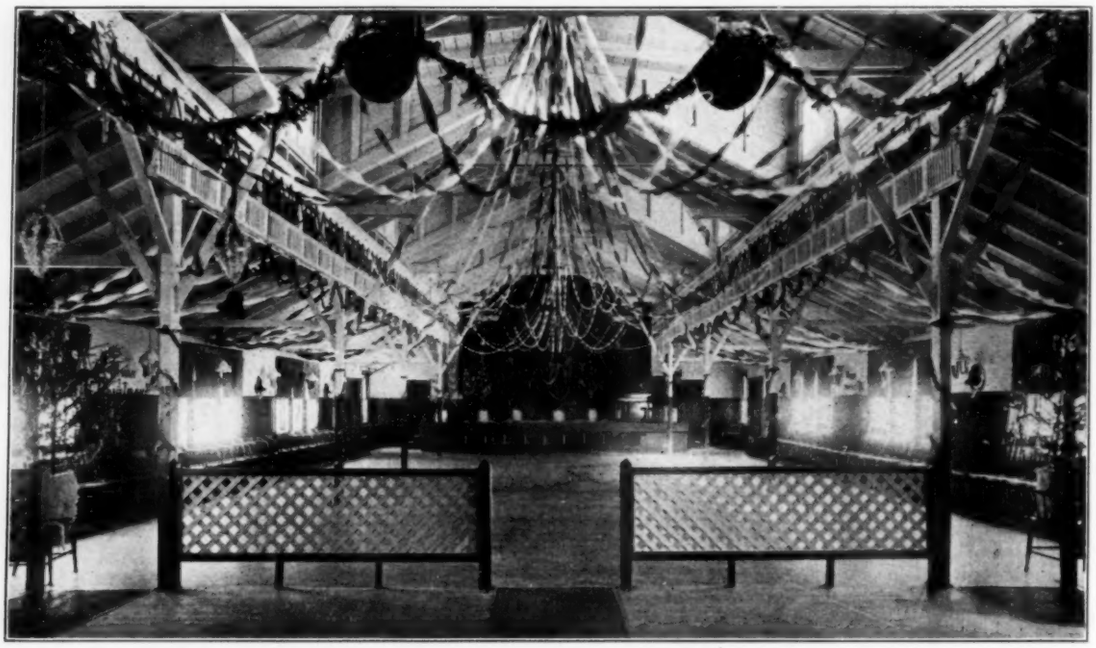
the instruction comprises an hour and a quarter each day in school. Instructors for this special training are secured from the Manufacturing Division of the Arsenal. They are experts in the various subjects they teach. The remainder of the working hours are spent in the company shops.

Sufficient repair work for the shop training is provided from work orders allotted to the Manufacturing Division of the Arsenal. In this manner it is possible for the organization to obtain tanks, tractors, trailers, trucks, 75-mm. guns, 155-mm. howitzers, 4.7-inch guns, rifles, pistols, revolvers, machine guns, etc. The repair of this equipment during the winter months, under trained supervision, accompanied by the special school courses, affords an opportunity for training the personnel in a very satisfactory manner.

As the training of the individual reaches certain advanced stages he is given work in the Manufacturing Division where he takes an active part in the production work at the Arsenal.

This company is the only one stationed at the Arsenal and a large amount of duty incident to the post necessarily falls upon the organization. This makes it impossible to give each member of the company special training at all times.

During time of war the organization would accompany corps troops and provide repairs and maintenance to all Ordnance matériel falling within the class allotted to Heavy Maintenance Companies.



Service Club, 33rd Ordnance Company, Rock Island Arsenal

Training

Owing to the large amount of special training necessary in the schooling of enlisted men in this organization, an effort is made in securing replacements to obtain only men who have served previously in line organizations. This eliminates the necessity of recruit instruction and gives more time to Ordnance activities.

During the school year from October to May, the men are given courses which provide a thorough grounding in the fundamentals of Ordnance maintenance and repair.

Definite courses are laid out and followed by the different sections throughout the school year. Each section spends an hour and a quarter each day in the class room under competent instructors who are specialists in their departments at the Arsenal.

Members of the Automotive Section are given a complete course covering engines, transmissions, clutches, tracks, etc., giving in detail the standard methods of overhauling and repairing of the various Ordnance vehicles which they are required to maintain.

The Artillery and Small Arms Sections pursue courses which take them through the details of maintenance and overhaul of all the artillery and small arms equipment that falls within the class of work assigned to Rock Island Arsenal in time of peace.

The machinists are given a course in mathematics which is in fact an abbreviated course of that given machinists' apprentices in the Manufacturing Division of the Arsenal. In addition to training in the reading of blue prints, laying out of various kinds of work, etc., they are instructed in the use of all the machine tools which are a part of the company equipment.

The blacksmiths and welders are given instruction in forging and in welding, with acetylene torch, of various kinds of metals as well as methods used in all types of repair with which they may come in contact.

In the shop the Automotive Section is required to disassemble vehicles such as tanks, make a thorough examination of all parts to detect any defective or unserviceable parts, secure replacements, reassemble the vehicle, and restore it to a serviceable condition. During overhaul of the vehicle, instruction is given concerning all important features, so that the men may become thoroughly acquainted with the work. Inspectors from the Manufacturing Division inspect all work and each vehicle must pass the same inspection and test as that required of work done by the Arsenal proper.

Annual Report of the Chief of Ordnance

Part I

By

MAJ. GEN. C. C WILLIAMS
Chief of Ordnance

THE following is a report of the principal operations of the Ordnance Department during the fiscal year ended June 30, 1924, under the following headings:

Personnel.
Training Projects.
Industrial War Plans.
War Reserves.
Experimental and Development Work and Manufacture of New Matériel.
Research and Ballistics.
Supply and Maintenance of Matériel.
Salvage.
Repairs and Improvements.

Personnel

Commissioned Personnel. On June 30, 1923, the commissioned strength was 294; on June 30, 1924, the total was 303, which included 204 commissioned in the Department, 17 detailed in the Department, and 2 retired officers called to active duty. The total authorized number for the fiscal year 1924 was 300, of which 245 were for Ordnance branch duty and 55 for non-branch duty.

The increased activities of the National Guard, Organized Reserves, and Ordnance District Offices are sources of increased demand for trained personnel. The demand for trained personnel for this class of work will be greater during the fiscal year 1925. In the fiscal year 1923 there were many retirements and separations from the service, due primarily to the operations of the act of June 30, 1922. The number lost have been replaced by transfers and details from other branches, and these replacements must be trained in ordnance work. This, therefore, decreases by a corresponding number the trained personnel available for this work and for other D. O. L. activities.

In the event of war the duties of ordnance officers will, in a great majority of cases, be confined to strictly ordnance work. The peace-time training of these officers, therefore, should be along ordnance lines. In order that such training may be given, an ample allotment of officers should be provided each year for duty at arsenals, depots, and proving grounds having the necessary training facilities. The number of officers authorized for these establishments has been insufficient. The 300 officers so authorized can not be considered sufficient until they all have received ordnance training and have all become available and qualified for any assignment.

It was impossible for the Ordnance Department to place a sufficient number of officers on duty with troops to comply with provisions of the National Defense Act, due to the fact that too few of the duties performed by officers of this Department were considered as duty with troops. The recent change in the law which permits exceptions to be made in the case of officers of the Ordnance Department, so far as duty with troops is concerned, will result in less changes of assignments and accordingly materially improve conditions.

Warrant Officers. On June 30, 1923, there were 55 warrant officers serving with the Ordnance Department. On June 30, 1924, the number was 55.

Enlisted Personnel. The actual enlisted strength on June 30, 1923, was 2,243; the authorized strength was 2,355, including 48 Philippine Scouts. On June 30, 1924, the actual strength was 2,362, and the authorized strength was 2,385. This number is not considered sufficient to meet the needs of this Department. Approximately all ordnance companies are organized at reduced strength in order to furnish the personnel required by Corps Areas, Departments, and exempted stations.

Ordnance Reserve Corps. On June 30, 1923, there were 2,461 Ordnance Reserve Officers. On June 30, 1924, there were 2,107; a net loss of 354 reserve officers. This loss is due to the expiration of the five-year period. The largest part of this loss was in the case of those commissioned from officers' training schools after the Armistice, and without actual service as officers. The losses which occurred after April, 1924, have been more than balanced by gains after that date.

Each reserve officer of the B. A. Group has been assigned specific duties in case of call to active service in an emergency, and has been so notified.

Training Projects

The Ordnance School. Instructions proceeded satisfactorily throughout the year. Course I, normally the first year, consists of an engineering course embracing theory of elasticity, heat engineering, advanced mathematics, chemistry of powders and explosives, power laboratory, ordnance engineering, and preliminary machine tool work. Course II, normally the second year, is essentially a practical course of instruction at the Watertown Arsenal, embracing arsenal administration, shop management, pyrometry, metallurgical chemistry, matalograph, testing materials, pattern making, foundry practice, including melting of metals, machine shop work, including operation of machines, assembling, forging and blacksmithing. Other courses provided are as follows: research courses, special courses, post graduate courses, and National Guard and Reserve Officers' courses. During the year the number of officers completing the courses were as follows: Course I, 16; Course II, 20; Special Courses, Post Graduate Courses, 2.

Ordnance Specialists School. This school is located at

the Raritan Arsenal. The general object of the school is to train officers and enlisted men in the duties which they may be expected to perform in that section of the Ordnance Department known as "Ordnance Field Service." Courses for enlisted men are conducted for machinists, machine operators, blacksmiths, welders, woodworkers, electricians, artillery-mechanics, armorers, leather-workers, auto mechanics, and tractor mechanics. Advanced courses are provided for advanced specialists. During the year 48 enlisted men of the Ordnance Department attended this school. No officers attended the school.

General Service Schools. Four officers attended the Command and General Staff School during the year; one a distinguished graduate and the other graduates. Four officers were graduates from the Army War College upon the completion of the 1923-24 course.

Special Service Schools. One officer pursued the Advanced Course at the Infantry School; one pursued the course at the Air Service Engineer School at Dayton, Ohio, and two officers pursued the course at the Advanced Flying School of the Air Service at Brooks Field, Texas; a total of four officers, as compared with the same number attending Special Service Schools of other branches during the fiscal year 1923.

Post Graduate Courses. One officer pursued a special course of ballistics at the University of Chicago, and one pursued a special course of accoustics at the University of Iowa. These courses afford an excellent means of advanced specialization in particular phases of ordnance work.

Commercial Organizations. One officer has been detailed at the plant of the Holt Manufacturing Company, Stockton, California. Details of this nature are not only valuable to the officers concerned and to the Ordnance Department, but also tend to interest the manufacturing establishments in ordnance problems and to bring them in closer touch with the Department.

Reserve Officers Training Corps. Units are maintained at the Massachusetts Institute of Technology, Yale University, Cornell University, Georgia School of Technology, University of Michigan, University of Cincinnati, University of Wisconsin, and University of California. The final enrollment in the advanced course was 345, as compared with 255 for the preceding year.

The R. O. T. C. Camp is conducted at Aberdeen Proving Ground, Md. The camp was attended by 123 students last year, and 159 students in 1924. It is strongly recommended that the policy be continued of holding the camp for all Ordnance Units (University of California excepted) at Aberdeen Proving Ground. The wide variety of proof, test, and other engineering work conducted at that station affords an excellent opportunity for training of this nature.

Reserve Officers Training. Due to lack of funds Ordnance Reserve Officers of the B. A. Group could not be called to active duty except in extremely limited numbers. Twenty-six Ordnance Reserve Officers voluntarily attended a three-days course of active duty without pay and allowances at Raritan Arsenal. Sixty Ordnance Reserve Officers of the B. A. Group assigned to procurement districts were trained at ordnance establishments under the allotment made the Assistant Secretary of War for training of reserve officers assigned to procurement duty. A limited number of officers were called to active duty at camps by Corps Area Commanders. However, no funds were authorized for training reserve officers assigned to the office of the Chief of Ordnance or to arsenals, proving grounds, or depots. The lack of funds for this training was keenly felt by the Ordnance Department and by the reserve officers with these assignments.

Civilian Personnel. The average number of civilian employees in the office of the Chief of Ordnance during the year was 241, a slight increase over the preceding year, which was due to the retransfer of certain portions of the designing work to this office, made possible by the increased expenditure for this purpose authorized by Congress. This retransfer permits of more satisfactory and efficient coordination of the work. The number of employees in the field was reduced during the year from 6,121 to 4,308. The total number of employees has been reduced from 80,237, at the time of the Armistice, to 4,548.

Industrial War Planning

We are only half prepared for war if man-power plans alone are developed. Plans for the prompt and efficient war-time utilization of industry from an important phase of war planning; in fact, such planning is peculiarly a necessity for supply branches if the war-time mission of providing the troops with what they need in sufficient quantity and at the time needed is to be fulfilled.

As noted in previous reports, the Ordnance Department has been giving considerable attention to industrial plans. The district system, devised to permit of decentralized contact with industry in the interest of planning in time of peace and control of production in time of war, has been fully developed. All of the fourteen districts called for in the project have been established.

At present, the districts are negotiating with manufacturers with a view to definite orders for ordnance matériel to be delivered in time of war. The Ordnance Department is devoting considerable time and energy to the supply of information to the manufacturers cooperating in this work, and there is reason to believe that each commercial firm scheduled to produce war matériel will prepare a war plan, at some expense to itself, which will provide the Government, at little cost, adequate munitions production plans to be put in effect in time of war. It is pertinent to remark in passing that, since munitions supply exercises such an important influence on the outcome of modern wars, plans of this type, if carried to their logical conclusion, can not fail to reduce the probabilities of war, or to shorten the combat in case war becomes the last resort.

Munitions plans can not be developed quickly. We have been engaged on this work for two years and it is expected that at least three years more will be required for their full developmnt.

War Reserves

Regardless of the perfection of industrial war plans, time is required to fabricate munitions, and there will always exist for several months at the outset of a war a dearth of the instruments of war, unless sufficient stocks are on hand in the depots to bridge the gap between demand and supply. These necessary stocks we recognize as the essential war reserves. Any munitions program must promise war reserves behind which the forces of industry may deploy in an orderly manner. Con-

gress recognized the principle of war reserves in the appropriation act for 1924, using the following words:

> "Under the authorization contained in this act, no issue of reserves or equipment shall be made where such issues would impair the reserves held by the War Department for two field armies, or one million men."

This provision protects the reserves for two field armies from depletion by issue. However, the very serious problem of maintenance still confronts the Ordnance Department. Funds are necessary to keep the authorized reserves in serviceable condition and to replace the deterioration of perishable articles. A program covering the funds for these purposes over a twenty-year period is in course of preparation and will be submitted, on completion, to the War Department with recommendation that Congress be asked to provide the sums necessary to maintain reasonable munitions reserves. The War Department, since the close of the fiscal year, has approved the above-mentioned program.

Experimental and Development Work and Manufacture of New Materiel

Immediately after the approval of the Caliber Board Program for the development of artillery and automotive matériel, the Department undertook the re-design of practically all its matériel. On account of lack of funds during the past years, the program has been finally contracted to cover reasonably well only infantry, pack and divisional matériel, the smallest caliber of antiaircraft matériel, and one type of tank.

The Department now finds itself unable to carry out even the contracted program during the coming fiscal year to an effective degree. New designs of matériel are ready for production of pilots, but funds are not available for their completion. This will delay development work on all present projects, and carry over beyond the fiscal year 1925 work which might, with ease, have been completed during that time were funds available. At the same time, the Department has a considerable number of other suspended projects which have been partially completed, or partly tested, and in which it is impossible to carry the test to conclusion and to correct mechanical defects.

The Department has now been working on the program for five years and can see no prospect of developing for the service and getting certain of the designs under the limited program ready for production without substantial increases in the funds available. Work which could, with a larger organization, be undertaken in one year, is now requiring three years to complete.

Rifles. Seven thousand, five hundred and forty-five service rifles were manufactured during the year. Four thousand, six hundred and thirty aiming devices, model of 1923, were manufactured for issue to the service. Orders for the gallery practice rifle, caliber .22, model of 1922, amounting to 3,300 were placed at the Springfield Armory during the year, but production was not begun because of certain changes in design found necessary.

Machine Guns. There is a requirement from the Air Service for 250 caliber .50 Browning aircraft machine guns, model of 1921, of which 106 have been manufactured. Fifty of these guns are being delivered by the Colt Patent Fire Arms Manufacturing Company at the present time and will be forwarded to the designated Air Service stations. Three hundred and fifty Browning Aircraft machine guns, caliber .30, model of 1919, were completed by the Colt Company and delivered. Of these, 50 are for the Army and the remainder for the Navy. Twenty Browning water-cooled machine guns, caliber .50, have been completed by the Colt Company and accepted by this Department. The Ordnance Department has developed and submitted to the Air Service a magazine for the caliber .30 Browning aircraft machine gun, model of 1919, to make this gun flexible. The Air Service has made preliminary tests of this magazine, and has requested a number for further service tests; these are now under manufacture.

Automatic and Semi-Automatic Rifles. The 20 Thompson automatic rifles, under manufacture by the Auto-Ordnance Company, for delivery to the Ordnance Department for service tests, have not yet been completed; two of these rifles have been delivered. Twenty-four Garand semi-automatic rifles have been manufactured by the Ordnance Department and are now undergoing tests preliminary to test by the using services. The design of the Pedersen semi-automatic rifle has been completed at the Springfield Armory and production of a working model is being inaugurated.

Machine Rifles. The production of 450 Browning machine rifles, at the Springfield Armory, for use by the Cavalry, has been delayed pending approval of a suitable type of stock rest and bipod. Designs of these two items have been approved, and orders for their manufacture have been placed with the Springfield Armory.

37-mm. Guns. The Colt Patent Fire Arms Manufacturing Company has developed and manufactured two 37-mm. automatic aircraft guns, one having a muzzle velocity of 1,350 f.s., the other 2,000 f.s. Preliminary tests of these guns indicate their suitability for Air Service use. In addition, the Ordnance Department has completed the design of, and now has under manufacture, 37-mm. automatic aircraft gun, having a muzzle velocity of 2,000 f.s.

Pistols. Under contract with the Colt Patent Fire Arms Manufacturing Company, 10,000 modified automatic pistols, caliber .45, model of 1911, were delivered during the year.

Small Arms Ammunition. The principal items of small arms ammunition manufacture during the year were 3,428,090 cartridges, caliber .30, Ball, National Match; 709,000 cartridges, caliber .45, Ball, National Match; 1,453,381 cartridges, caliber .30, Tracer; 232,710 cartridges, caliber .50, Armor-Piercing.

Experimental work has been continued during the year on the development of suitable caliber .30 and caliber .50 tracer ammunition, and while the final type of neither has been evolved, a satisfactory cartridge has been made, and caliber .30 tracer ammunition is under manufacture for issue. The 1924 National Match ammunition has proved to be the best of all ammunition yet produced; it is very accurate and has an extremely long range.

Pack Howitzer Matériel. Satisfactory progress has been made during the year in the construction and test of pilot pack howitzer matériel, model of 1923-E, Type B, referred to in my last annual report. The tests to date indicate that this 6-pack, 9,000-yard weapon is a practical type, since all of the loads are within the weight limit of 225 pounds, and can be packed with facility. The carriage can also be transported on its wheels, when desired. It is purposed to send this pilot to the Field Artillery for trial as soon as possible, in order that

early decision may be made as to the next step in this important development project. Negotiations for the purchase of a foreign sample of long-range pack matériel were abandoned when it became evident that the price quoted by the manufacturer was unreasonably high.

Divisional Artillery. The Field Artillery Board has completed comparative tests of the two types of carriages for the new long range 75-mm. gun, namely, the model of 1920 split-trail carriage, and the model of 1921 box-trail carriage. Due to excessive weight and the complications incident to make the carriage interchangeable for mounting either the 75-mm. gun or the 105-mm. howitzer, and providing for an elevation of 80 degrees, the model of 1920 split-trail carriage has been eliminated from further consideration as a mount for the divisional gun. The model of 1921 carriage, however, proved very satisfactory as a type, but the question as to whether the divisional gun should be mounted on a split-trail, or a box-trail type of carriage has not yet been definitely determined, and can not be until after completion of the test of the split-trail 75-mm. gun carriage, model of 1923. This pilot has been designed to be comparable with the model of 1921 carriage as to weight, elevation, length of recoil, etc. The manufacture of this pilot has been completed and the Ordnance test is now in progress.

The manufacture of a new 105-mm. howitzer carriage of box-trail type, designated model of 1925-E, is in progress. In the design of this carriage the independent line of sight system has been eliminated, and a maximum elevation of 65 degrees is being provided, as desired by the Chief of Field Artillery. As in the case of the 75-mm. gun, it has not been definitely settled whether the box-trail or the split-trail type of carriage will be adopted for the 105-mm. howitzer, but it is expected to arrive at a decision after the 75-mm. carriage, model of 1923, and the 105-mm. howitzer carriage, model of 1925, have been compared in the test to be carried out by the Field Artillery Board.

The Field Artillery Board has made a thorough test of the German 105-mm. howitzer matériel, and it is expected to prepare some of this matériel for issue, if the recommendations of the Chief of Field Artillery shall be approved by the War Department. Before issue, the German howitzers must be re-chambered to fit our service ammunition. A general overhaul of the carriage will also be necessary. Plans are being made to carry out this work to the extent that funds become available from year to year.

Corps Artillery. Satisfactory progress is being made at the Proving Ground in the test of the 4.7-inch gun carriage, model of 1921, and it is expected to deliver it in the early fall for test and criticism by the Field Artillery Board.

As originally designed the 155-mm. howitzer carriage was intended to mount the 155-mm. howitzer and the 4.7-inch gun; but due to the interchangeable feature it proved entirely unsatisfactory as a gun carriage. As a howitzer carriage, there are certain features which require improvement before it can be considered satisfactory. The Department has completed the preliminary test of this matériel and has turned over one unit to the Field Artillery Board, for test and criticism, with a view to obtaining suggestions for improvements which may be incorporated in a design of a new pilot under way, and which will be known as the 155-mm. howitzer carriage, model of 1925. The howitzer will be of the same power as that for the 1920 carriage, with maximum range of 18,000 yards; the carriage will be designed for elevations up to 65 degrees.

A transport wagon was provided with a model of 1920 matériel, but was not found satisfactory as designed. After the elimination of the gun from this unit, it was decided to redesign the transport wagon so as to make it more suitable for the howitzer. Further tests will be carried on at the Proving Ground and, if results warrant, will be continued by the Field Artillery Board. It is not desired to provide a transport wagon for the gun on the model of 1921 carriage, in view of the fact that the total weight, in the traveling position, is approximately 12,000 pounds; but it may be desirable to have a transport wagon for the 155-mm. howitzer.

Army Artillery. Minor modifications are being made from time to time in the 155-mm. gun—8-inch howitzer carriage, model 1921, and tests at the Proving Ground are being continued. It is expected to release this unit for service test during the coming year. A transport wagon was provided for this unit, but was found unsatisfactory in certain respects when transferring the cannon to and from the carriage. The wagon will be modified and further tests made at an early date.

240-mm. Howitzer Matériel, Model of 1918. The project of utilizing the matériel in coast defenses having received the approval of the War Department, estimates for the required funds are now in course of preparation. As a result of experience in using two batteries of this matériel at Fort Bragg, the Field Artillery have suggested desirable modifications in the method of emplacing the matériel and of transporting it. This matériel, originally designed in France, has been found very satisfactory as to type, but does not permit the best utilization of caterpillar tractors in emplacing. The necessary changes in design will be worked out so that modification may be promptly made in case of emergency.

Caterpillar Adapters. A recommendation has been submitted to the War Department that further development work to provide caterpillar adapters for the 155-mm. gun carriage and the 8-inch howitzer carriage be abandoned. This recommendation was based on the report of tests by the Coast Artillery and Field Artillery. In the case of the 155-mm. gun carriage it was found that mobility was not improved by the addition of adapters. In the case of the 8-inch howitzer carriage, it is the consensus of opinion that the expense of modifying all carriages in service would not be justified, in view of the unsatisfactory range of the howitzers, and of the fact that it is desired to substitute the 240-mm. howitzer for the 8-inch howitzer as soon as a suitable war reserve of ammunition for the former can be provided.

155-mm. Trench Motar, Model of 1920. The Department has suspended tests of this matériel, and has turned it over to the Coast Artillery for trial before undertaking further development.

Panoramic Sights. Two types of mounting panoramic sign on 75-mm. gun, model of 1897, were tested by the Field Artillery Board during the year, and, based upon the criticism and recommendation of the Board, two other types are under construction; these should be ready for test in the near future. The Chief of Field Artillery is desirous of developing a type that can be applied to the model of 1897 carriage for the purpose of training personnel in the use of the panoramic sight.

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16-inch Gun Barbette Project. Six 16-inch, 50-caliber guns, on barbette carriages, were in process of erection during the fiscal year. This work is nearing completion and it is expected that these batteries will be turned over to the Coast Artillery early in the fiscal year 1925. On June 30, 1924, a total of twelve 16-inch barbette carriages had been completed and the remaining two under present orders were about 80 per cent completed. Eight Army 16-inch, 50-caliber guns, were manufactured for the first six carriages, thus providing two spare guns. Navy 16-inch, 50-caliber guns, made available as a result of the Treaty on Limitation of Armaments, will be mounted on the remaining carriages.

16-inch Howitzer Carriages. The mounting of four 16-inch howitzers in seacoast defenses was nearly complete on June 30, 1924; it is expected that these howitzers will be turned over to the Coast Artillery sometime during the ensuing fiscal year.

14-inch Railway Project. The pilot 14-inch railway mount, model of 1920, has been under test at the Aberdeen Proving Ground during the fiscal year. Firing from the mount have been completed, both from the 360 degree platform and from the field platform. The tests indicated that the mount permitted of a very satisfactory rate of fire. This project will be continued during the coming fiscal year.

3-inch Antiaircraft Gun Mount, Model of 1917 MI. One 3-inch antiaircraft gun mount, model of 1917, was modified to overcome existing defects. The modified carriage was tested at the Aberdeen Proving Ground and found satisfactory for service. This carriage will be included in the list of standard matériel, and the new design will be used for future manufacture.

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Fire Control. A large program of experimental work in connection with the development of fire-control apparatus for long-range seacoast guns and for antiaircraft guns has been carried out during the present fiscal year, and considerable progress toward the solution of these problems has been made. A manufacturing order for 20 Cloke plotting boards, a type recently recommended for adoption by the Coast Artillery, is nearing completion at the Frankford Arsenal, and these boards are now being shipped to the service. A number of 110-degree plotting boards have also been completed during the year. A new type of panoramic telescope, designed for railway artillery, was manufactured, and tested by the service at Fort Monroe.

Studies and experiments have been under way looking to the development of observation instruments to be used in aircraft in connection with mobile and fixed artillery.

One of these is an airplane spotting instrument designed for use by an observer in an airplane or balloon to measure accurately the magnetic bearing of the point of impact of a projectile with reference to the target, these data, when obtained, to be signaled back to the batteries, and adjustment of fire made accordingly. The others are airplane observation instruments designed for use in airplane to locate targets in unmapped areas, not visible from the gun battery. Still another is a balloon observation instrument designed for the same use as the airplane instruments, but constructed along very different lines. Tests of these instruments have been made by the using services with the result that one of the airplane observation instruments will be returned, after some modifications, to the service for further test. This instrument consists primarily of a telescope, recording mechanism, collective lens, and reflecting prisms, objectives and mirrors, and a ball-and-socket mount.

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Azimuth Instruments, K. & E., with chests.
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(*To be continued in March-April* ARMY ORDNANCE)

early decision may be made as to the next step in this important development project. Negotiations for the purchase of a foreign sample of long-range pack matériel were abandoned when it became evident that the price quoted by the manufacturer was unreasonably high.

Divisional Artillery. The Field Artillery Board has completed comparative tests of the two types of carriages for the new long range 75-mm. gun, namely, the model of 1920 split-trail carriage, and the model of 1921 box-trail carriage. Due to excessive weight and the complications incident to make the carriage interchangeable for mounting either the 75-mm. gun or the 105-mm. howitzer, and providing for an elevation of 80 degrees, the model of 1920 split-trail carriage has been eliminated from further consideration as a mount for the divisional gun. The model of 1921 carriage, however, proved very satisfactory as a type, but the question as to whether the divisional gun should be mounted on a split-trail, or a box-trail type of carriage has not yet been definitely determined, and can not be until after completion of the test of the split-trail 75-mm. gun carriage, model of 1923. This pilot has been designed to be comparable with the model of 1921 carriage as to weight, elevation, length of recoil, etc. The manufacture of this pilot has been completed and the Ordnance test is now in progress.

The manufacture of a new 105-mm. howitzer carriage of box-trail type, designated model of 1925-E, is in progress. In the design of this carriage the independent line of sight system has been eliminated, and a maximum elevation of 65 degrees is being provided, as desired by the Chief of Field Artillery. As in the case of the 75-mm. gun, it has not been definitely settled whether the box-trail or the split-trail type of carriage will be adopted for the 105-mm. howitzer, but it is expected to arrive at a decision after the 75-mm. carriage, model of 1923, and the 105-mm. howitzer carriage, model of 1925, have been compared in the test to be carried out by the Field Artillery Board.

The Field Artillery Board has made a thorough test of the German 105-mm. howitzer matériel, and it is expected to prepare some of this matériel for issue, if the recommendations of the Chief of Field Artillery shall be approved by the War Department. Before issue, the German howitzers must be re-chambered to fit our service ammunition. A general overhaul of the carriage will also be necessary. Plans are being made to carry out this work to the extent that funds become available from year to year.

Corps Artillery. Satisfactory progress is being made at the Proving Ground in the test of the 4.7-inch gun carriage, model of 1921, and it is expected to deliver it in the early fall for test and criticism by the Field Artillery Board.

As originally designed the 155-mm. howitzer carriage was intended to mount the 155-mm. howitzer and the 4.7-inch gun; but due to the interchangeable feature it proved entirely unsatisfactory as a gun carriage. As a howitzer carriage, there are certain features which require improvement before it can be considered satisfactory. The Department has completed the preliminary test of this matériel and has turned over one unit to the Field Artillery Board, for test and criticism, with a view to obtaining suggestions for improvements which may be incorporated in a design of a new pilot under way, and which will be known as the 155-mm. howitzer carriage, model of 1925. The howitzer will be of the same power as that for the 1920 carriage, with maximum range of 18,000 yards; the carriage will be designed for elevations up to 65 degrees.

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(*To be continued in March-April* ARMY ORDNANCE)

Status of U. S. Navy Ordnance

By

REAR ADMIRAL C. C. BLOCH

Chief, Bureau of Ordnance, Navy Department

EXTRACTS FROM THE ANNUAL REPORT, 1924, OF THE CHIEF, NAVY BUREAU OF ORDNANCE

THE fundamental naval policy as adopted is as follows: The Navy of the United States should be maintained in sufficient strength to support its policies and its commerce and to guard its continental and overseas possessions.

The general naval policy which has been adopted is: To create, maintain, and operate a Navy second to none and in conformity with the ratios for capital ships established by the treaty for limitation of naval armaments.

Conforming to the above policies, it has been the desire and effort of the Bureau of Ordnance to expend its appropriations for: (a) Maintenance of the fleet; (b) Research and development of new ideas and materials; (c) Care of reserve stocks of matériel on hand and the supplying of any deficiency in these stocks; and (d) Maintenance of necessary ordnance stations. Any expenditures found not to be directed along these lines have been considered unnecessary and have been eliminated as discovered.

Subsequent to the World War the work of reduction in expense was begun, and as a result of the Administration's policy of retrenchment there is concerted effort for economy of operation and consequently a much stricter supervision over all activities. In 1915 the main working appropriation of the bureau, "Ordnance and ordnance stores," amounted to $5,800,000. On the 1st of July, 1924, the average wage of employees was approximately 165 per cent of what it was in 1915. The cost of material has increased proportionately. There are now more naval vessels in commission than there were in 1915. The stock of reserve material requiring care and attention on hand at the present time is several times as great as it was in 1915. Notwithstanding these increases in the cost of labor and material and the greater amount of work to be done at the present time, the present appropriation has only increased 55 per cent. In other words, there has been an increased economy of operation. This is further evidenced by the appended table, giving the number of employees at the Naval Gun Factory, which indicates that in 1924 there were less employees at this establishment than there have been at any time since 1905:

Year	Employees
1905	3,805
1910	3,397
1915	3,495
1918	10,986
1924	2,239

Airplane Catapult

A new type of airplane catapult has been developed conjointly by the Bureau of Ordnance, Bureau of Aeronautics, and Bureau of Construction and Repair. Smokeless powder is used as the propellant in the new type of catapult and most excellent results have been obtained. By using this type, a more reliable catapult has been obtained, and the use of compressed air with its cumbersome and expensive compressing machinery has been obviated. Incidentally, the design has been simplified and the general arrangement made very much better for installation on board ship.

Aircraft Float Lights

An aircraft float light, which is designed to ignite on hitting the water or the ground and which is used for illuminating the place of landing at night and for the purpose of determining the drift of aircraft, has been developed by the bureau. A number of these float lights were made to be used by the *Shenandoah* on its proposed polar flight and a number were also manufactured and supplied to the Air Service of the Army for use in connection with the Army round-the-world flight. The bureau's information indicates that this development has proved successful for the purpose intended.

Repeal of Appropriation for Gun Elevation

The last session of Congress repealed the appropriation of $6,500,000 made available by the third deficiency act, approved March 4, 1923, for the purpose of increasing the elevation of turret guns of 13 battleships. None of this money had been expended for the reasons set forth in the Annual Report of the Secretary of the Navy for the fiscal year 1923. Through the development of the airplane it has been found practicable to conduct firing at ranges far in excess of ranges now obtaining on 13 of our 18 battleships. However, it will be impossible to take advantage of this recent development on any but 5 of our most recent battleships owing to the fact that the appropriation for increasing gun elevation of the remaining 13 ships has been repealed.

Obsolete Projectiles

During the fiscal year the bureau has caused a complete survey, inventory, and invoice of all stocks of reserve material held in store. As a result of this survey and the scrapping of naval vessals required under the treaty for limitation of armaments, it was found that there was on hand a large amount of useless and obsolete material. Such of this material as could be safely and advantageously disposed of was sold at public auction. That which could not be sold was otherwise disposed of.

Technical Force

The bureau's technical force for the past year has been engaged in investigation of items of major importance. Designs for new construction, either recommended to

Congress or contemplated for the future, have been studied. With the small technical force available only the most urgent designs can be considered.

The matter of the employment of adequate technical personnel cannot be given too serious consideration. Design work may be considered to bear but little relation to manufacture and repair work at times when little manufacture and repair work is being undertaken. However, in the opinion of the bureau it is of paramount importance that research and development be kept well in hand and designs for future material be kept up to a point where production may be begun at any time. If the Nation should suddenly be confronted with an emergency, new vessels and new equipment will be required and the designs for such should be prepared in advance in order that there may be no costly and serious delays.

The activities of the inspection force for the year ending June 30, 1924, have been carried on by a constantly decreasing personnel. At every opportunity the bureau has consolidated its inspection offices with other bureaus, has closed offices and has reduced personnel in order to meet requirements of the situation and to conserve public funds. The appended table will give a comparison as to the personnel employed on the 1st of July, 1924.

	1923	1924
Officer personnel	24	21
Civilian personnel	46	29

The work performed by the clerical, technical, and inspection force has been entirely satisfactory, and it is felt that a public acknowledgement of this fact is due to these employees. The bureau desires to express its keen appreciation for the loyal, painstaking, and efficient support of these employees.

Patents

During the past year the patent section of the bureau has been actively engaged in prosecuting the numerous patent applications for the different bureaus of the Navy Department and at present there are 91 cases under prosecution. Thirty applications have been allowed within the past year and approximately 20 applications were filed during the year.

A large part of the time of the patent section was also devoted to assisting the Department of Justice in prosecuting several interferences for the benefit of the Navy Department. One of these interferences, namely, Harrison v. Browne, went to final hearing and a decision was rendered giving Browne, assignee to the Navy Department, all of the broad counts in issue. An appeal is being taken in the more specific counts.

Numerous investigations have been made regarding the patentability and infringement of various devices and construction for this and other bureaus.

Supply of Ordnance Material

Following the winter maneuvers of 1924, the efficacy of the supply of ordnance material to the fleet was investigated. This investigation showed allowances, in the main, to be adequate and replenishment of consumed material to be expeditous in so far as it related to this bureau.

Ordnance allowance lists have been kept up to date to include material required by the latest developments and practices.

Specifications

A large amount of work on specifications has been accomplished by the bureau during the past year. With the establishment of Federal specifications it has been necessary to revise Navy Department leaflet specifications or to prepare new specifications. The value of the work of the Federal Specification Board is daily becoming more apparent. In no case have the Federal specifications covering material in which the bureau is interested been other than satisfactory.

Machinery

The bureau has been able to effect economies for other bureaus by transferring surplus machinery and machine tools from the supply on hand at the naval ordnance plant, South Charleston, W. Va., to those bureaus. The equipment of other ordnance plants has likewise been improved by this method without expenditure of funds.

Small Arms and Machine Guns

The work of reclaiming and returning to service small arms and landing-force material is being proceeded with at the naval operating base, Hampton Roads, Va., and at the navy yard, Mare Island, Calif.

Battle Towing Targets

During the fiscal year 13 battle targets have been surveyed and condemned; 8 new targets have been constructed and are now in service. Tests with high-speed towing target have been conducted, but have not been successful.

Guns

The regunning program has been closely followed. Two capital ships have been regunned during the past fiscal year. The guns removed from these ships have been returned to the Naval Gun Factory and work on relining them has been started.

Manufacture of 5-inch guns for aircraft carriers has progressed satisfactorily.

The 8-inch guns for aircraft carriers are being manufactured by the Naval Gun Factory and the Watervliet Arsenal. The first of these guns will be ready for proof in the near future.

Turret Installations

All turret material for the *Colorado* and *West Virginia* has been installed and tested. Designs for the turrets of airplane carriers have been completed and production is being proceeded with.

Broadside Gun Mounts

A number of 5-inch broadside gun mounts are under manufacture for installation on airplane carriers; three of them have been completed and tested.

Mines

In general, the only work done in connection with mines has been of an experimental nature, looking toward the development of material.

Mining practices by the forces afloat have been gradually extended in scope with the result that the bureau is now receiving helpful suggestions in connection with future design.

During the year all submarine net material has been assembled, overhauled and distributed to points of stowage.

Aircraft Ordnance

Steps toward equipment of new aircraft have been taken and contracts have been let for the manufacture

of ordnance material for planes building. Orders have been placed for the manufacture of a number of bombs for stock as well as service allowance for airplane carriers.

Improvements in target material have been made and improved types of towing sleeves, together with reels and release mechanisms, have been acquired.

Fire Control

During the fiscal year 1924, the bureau has been completing fire-control equipment for 3 battleships of the *Colorado* class, 6 light cruisers, and 12 destroyers. The installation of this equipment on all vessels will be completed as soon as practicable.

Orders have been placed for the fire-control systems of the main batteries of the *Lexington* and *Saratoga* and delivery will be made in time for installation in order that the vessels may be completed according to schedule.

Efforts have been made to improve the installations in service and to maintain an adequate supply of spare parts for keeping the equipment in efficient condition.

During the World War the optical industry of the country was expanded and developed to a very much higher standard than existed prior to the war, and this fact, together with rigid specifications and inspection, enables the bureau to advocate the policy of purchasing all high grade optical instruments in this country.

The bureau has endeavored to supply new construction with the most modern and efficient systems of fire control obtainable. In designing and purchasing this material, the bureau has utilized the experiences of the last war.

Torpedoes

All torpedo manufacture has been confined to the naval torpedo station, Newport, R. I. The naval torpedo factory at Alexandria, Va., is used only for the purpose of stowing inactive torpedoes. Only a small number of employees are engaged in Alexandria and they are only utilized for the purpose of care and preservation and overhaul of torpedoes in storage at that place.

Plans have been completed for the modernization of all torpedoes in the service requiring it, and the torpedo station at Newport has been given orders to start the work, which will be continued as rapidly as funds are available. The bureau considers this project to be of major importance and will prosecute it vigorously.

Powder

During the year there have been manufactured 1,444,470 pounds of powder, an amount just sufficient to take care of target practice requirements of the fleet. All powder has been manufactured at the naval powder factory, Indian Head, Md. The amount manufactured permits production at Indian Head of a small daily output, which, in addition to supplying the needs of the service, serves to keep the machinery in an operating state and to maintain a nucleus of manufacturing organization.

Armor

No armor has been manufactured during the fiscal year. All armor not required for the use of the Navy or other governmental departments has been disposed of.

The naval ordnance plant at South Charleston, W. Va., has been in an inoperative status and the only work done has been confined to necessary upkeep at that station.

Experimental

Experimental work has been continued at the proving ground, powder factory, torpedo station, Naval Gun Factory, and naval laboratory to the fullest extent of available funds. Other governmental agencies, such as the Bureau of Standards, Bureau of Mines, and Chemical Warfare Service, have assisted in experimentation. A number of commercial firms' civilian experts have been employed for research work in laboratories better equipped for certain specific processes than laboratories owned and operated by the Government.

Investigations have been conducted in new high explosives and propellant powders, both for guns and torpedo tubes, various types of projectiles, torpedo firing mechanism, torpedo power plants, fuzes, bombs, and pyrotechnic signals.

Special Board on Naval Ordnance

The special board on naval ordnance has examined and reported on numerous inventions relating to guns, mines, fuzes, torpedoes, and other devices submitted to the bureau. A few of these have been found to be useful. Encouragement has been given to individuals to present their devices for examination in order that the bureau may be kept in touch with the inventive genius of the country.

The board has carefully analyzed, with particular reference to matters connected with ordnance material, the firings of batteries of new and regunned ships, with various target practices which have been fired and the various ordnance and gunnery data especially collected by the fleet.

The bureau has cooperated closely with the Ordnance Department of the Army and periodic meetings of the special board and Army technical staff are had in order that each may have close touch with what the other is engaged in. Useless duplication is prevented in this way.

Naval Gun Factory

Due to improvements in management and equipment, marked economies have been accomplished in the forge and foundry work at the Naval Gun Factory. In several cases the cost of finished products has been reduced in price by approximately 25 per cent.

The work done by the physical laboratory in testing material and in maintaining a high standard of excellence in raw materials has resulted in greatly reducing rejections of finished material. This has resulted in economy and rapidity of production.

The optical shop has done excellent work by improving and simplifying many types of optical instruments important to the accuracy of gun fire. Improvements have also been made in method of manufacture and in testing raw material.

During the past year the planning division has submitted estimates on work amounting to $1,871,475. The final costs were less than the estimates by about six-tenths of 1 per cent. This reflects great accuracy in estimates at the gun factory and also reflects credit on the shops to produce the material in accordance with estimates made before manufacture is begun.

A fire-control school was established at the Naval Gun Factory during the latter part of the fiscal year. The school is now in operation and the bureau feels confident that its value to the service will be great.

Naval Powder Factory

During the year, 1,444,470 pounds of powder were manufactured at the powder factory. The cost of powder was somewhat increased owing to the small quantity produced.

Experimental work has been conducted at the laboratory of the powder factory in connection with surveillance of various explosives under atmospheric and varying temperature conditions. Many new explosives were analyzed and tested and a number of new materials were prepared for test at the proving ground in connection with development work.

Naval Ammunition Depots

Ammunition depots have met all calls for preparation of service and target practice ammunition. The care, upkeep, and proper overhaul of ammunition stocks constitutes a problem to the bureau, as at some of the ammunition depots there are large stocks of ammunition, turned in at the end of the war, which must be carefully gone over and put in a state for future use.

Naval Proving Ground

During the fiscal year a large amount of work was done at the proving ground in connection with proof of guns, proof of powders for service, proof of target-practice powders, proof of projectiles, firing for ranging data, test of fuzes, and experimental work.

The total number of rounds fired by the proving ground during the year was 4,083. Total amount of powder expended for proof and experimental work was 381,000 pounds.

Naval Ordnance Plant, Baldwin, Long Island, N. Y.

During the year 17,000 projectiles were completed and issued to the service; the average number of employees amounted to 135.

Naval Torpedo Station, Newport, R. I.

As a depot for the storage, issue, and supply of ordnance material, the torpedo station keeps on hand a considerable number of torpedoes for issue, together with the necessary tools, accessories, and spare parts. It has issued a large number of complete torpedoes to the fleet and maintains torpedoes in a ready condition, sufficient in number to meet all anticipated demands.

As the Navy increases in size the need for additional storage and for better issuing facilities becomes more and more apparent. A new storehouse for torpedoes and new docks alongside which to berth destroyers and thus enable the expeditious issue of torpedoes to them have been recommended.

Instruction of personnel in torpedoes forms one of the major activities of the station. The officers completing a six months' course in torpedo work numbered 66. One hundred and thirty enlisted men have completed the regular course, and 98 men have taken special courses. The enlisted men taking such courses should be of the very best type the service possesses if torpedoes are to be efficiently handled in war. No other instrument of war is more powerful or more difficult to operate. It is a weapon of great precision when properly used, but valueless when requisite skill is not employed. The personnel of the torpedo group of the Navy must be specially selected and instructed.

The instruction of apprentice machinists has been carried out along ever-improved lines, practical work, recitations, and lectures, all being utilized in order to improve the standard of the school.

Progress in torpedoes, as in all weapons of war, demands the attention of skilled technical officers. The shortage in such is acutely felt in every line of endeavor at the station. The Navy does not sufficiently recognize the fact that technical personnel is required, and where in the foreign admiralties 10 to 15 officers are available for special work but 1 or 2 are detailed in our service. There is now but one line officer of this type more than there was in 1916. The years of peace are the ones to be devoted to progress. Additional technical line officers are needed at the station if our torpedo progress is to continue.

The torpedo station entered upon the fiscal year with a force 40 per cent less than that employed during the previous year and continued throughout with an average force of 935, as compared with 1,552. Many administrative methods have been altered and the result has been increased production, better appearance of the shops, and improved morale throughout. For instance, despite the smaller force, nearly as many torpedoes were completed, proved, and stored during the year as in the previous year, and there remained more torpedoes in shops awaiting proof this year than last year, this representing actually more torpedoes for the year. More torpedoes have been modernized and converted than during the previous year. The maintenance of ships has been improved both in cleanliness and in the completion of the installment of appropriate safety devices. The new policies in regard to personnel control have effected very tangible benefits to both the Government and the employee. This is well testified to by the increase of production per capita, a marked improvement in the attendance records of the employees, and the exceedingly rare instances of reprimand or disciplinary action.

Numerous economies have been introduced into the station's routine. The amount of coal consumed and its price has been reduced greatly; by hauling its own freight the station has obtained a direct saving; the water bill has been reduced by over one-third; and throughout the plant, by attention to minor operations in manufacture and many improvements in multiple work, there have been netted actual savings.

Research and development have continued along lines indicated from time to time in the development of the torpedo art and have resulted in real advance, greatly contributing to making the torpedo ever more and more a reliable weapon. Such progress is limited only by the number of technically trained officers and civilians available.

Pacific Coast Torpedo Station, Keyport, Wash.

This station is principally a storage point and a place for testing torpedoes belonging to vessels of the Pacific Fleet. It is utilized by battleships and destroyers of the Pacific Fleet practically the entire year, and is of great value to personnel of the fleet in connection with overhaul of torpedoes and instruction of personnel.

Editorials

Rock Island Arsenal

THIS number of ARMY ORDNANCE is dedicated to the Rock Island Arsenal, the largest and one of the most important of the permanent establishments of the Army Ordnance Department. The articles published herein describe the Arsenal, its history, its organization, and some of the more important of its major activities.

Rock Island is a monument to the genius of our Ordnance leaders. Founded in the days when our great Western frontier had not been extended to the sea, it served as a military post during the critical pioneer days of our history. Of strategic importance during those somewhat primitive but none-the-less heroic times, it was a focal point from which the lines of command and organization reached out.

During our Civil War, it came into being as an arsenal and continuously since that time it has filled an important role as provisioner of the stalworth hosts who have served in the nation's defense. "The Essen of America" it was hailed during the World War, and it stands today a tribute to the men who were charged with munitions manufacture and supply in the past. Here were designed and manufactured many of the implements that have helped to make our history. Rodman, Flagler, and a galaxy of others must rise to share the praise for this truly great institution, while those of our own generation, the present commanding officer and his immediate predecessors, are entitled to much credit for its recent gigantic development.

Those who would decry the need of armament might well study the life history of this great arsenal. They would find it in a model establishment devoted to the one proposition—defense. At its drafting boards are studied and devised the implements by which war is dethroned and peace established. At its furnaces and hearths are welded the giant guns and caisons that roll on to victory. In its shops are fabricated and tested the things of the soldier upon whom we must rely when our peace is threatened. And as we regard the majesty of the law ready and anxious to protect the rights of our people, and the physician at hand to remedy the ills that human kind is heir to, so also should we consider this instrument of defense whose products are the successors of the bow and lance of by-gone days but whose purpose is equally as chivalrous and as necessary.

Rock Island is not so fortunate as another of our Arsenals that furnished the immortal Longfellow with a theme. Nor has it always shared proportionately in the glory that has been meted out to men and things held up for public praise. Albeit, Rock Island is a silent sentinel standing in the midst of our domain, able and ready to beat plowshares into armament and back again whenever the defensive needs of our people require. Its important place in our scheme of protection is here described for the benefit of our readers, so that they may know and understand the history and meaning of a bulwark that has often been tried and never found wanting—Rock Island Arsenal.

Ordnance Progress—1924

ELSEWHERE in this issue are published Part I of the Annual Report of Major General C. C. Williams, Chief of Ordnance of the Army and excerpts from the annual report of Rear Admiral C. C. Bloch, Chief of the Bureau of Ordnance of the Navy, both for the fiscal year ended June 30, 1924. The two reports are well worth careful perusal and thought. The Chiefs of the Army and Navy Ordnance Departments deserve high praise for the results reported. Ordnance, both military and naval, is holding its own, and although the work to be done—particularly as disclosed by General Williams—is great, and progress on certain approved programs is not as rapid as might be, even so, both classes of ordnance development are in the hands of highly competent men who may be depended upon to do all that can be done under present limitations.

But we do not say that all possible progress has been made. The organization in the Ordnance Department is ready to go but the werewith is lacking. Thus, in General Williams' words, necessary progress as to experimental and development is seriously delayed:

"Immediately after the approval of the Caliber Board program for the development of artillery and automotive matériel, the Ordnance Department undertook the redesign of practically all its matériel. On account of lack of funds during the past years, the program has been finally contracted to cover reasonably well only infantry, pack and divisional matériel, the smallest caliber of antiaircraft matériel, and one type of tank.

"The Department now finds itself unable to carry out even the contracted program during the coming fiscal year, to an effective degree. New designs of matériel are ready for production of pilots, but funds are not available for their completion. This will delay development work on all present projects, and carry over beyond the fiscal year work which might, with ease, have been completed during that time were funds available. At the same time, the Department has a considerable number of other suspended projects which have been partially completed, or partly tested and in which it is impossible to carry the test to conclusion and to correct mechanical defects.

"The Department has now been working on the program for five years and can see no prospect of developing for the service and getting certain of the designs under the limited program ready for production without substantial increases in the funds available. Work which could, with a larger organization, be undertaken in one year, is now requiring three years to complete. * * * "

It is to be hoped that larger appropriations will be forthcoming so that this important work may go on at the proper pace.

Of its very nature Ordnance is an art which must ever develop. Study, design, development and test are functions which must keep apace with research in every branch of scientific endeavor. The mechanical feature cannot lag behind the metallurgical, the chemical cannot be discarded for the physical—all must proceed equally and all must keep abreast of commercial and scientific progress. To be remiss in one branch is to force out of alignment a delicately balanced whole, upon the smooth and proper working of which great interests and the security and peace of millions are at stake.

Newly-Elected Officers of A. O. A.

WITH the beginning of the New Year the recently elected officers of the Army Ordnance Association enter upon their terms of office. As announced in the November-December, 1924, issue of ARMY ORDNANCE, Mr. Benedict Crowell was reelected to the office of President, a duty which he has performed faithfully and well since the foundation of the Association six years ago. Under the new constitution of the Association the President and Vice-Presidents will serve terms of 2 years each. Mr. W. W. Coleman, of Milwaukee, Wisconsin, who also filled this office since the organization of the A. O. A. was reelected to the Vice-Presidency and Gen. Guy E. Tripp, of New York City, was also elected a vice-president, the new constitution providing for two vice-presidents for terms of two years each. Both encumbents have been ardent supporters of industrial preparedness and indefatigable workers in the interests of the Association.

The Board of Directors of the Association now comprises, in addition to the President and the Vice-Presidents, Messrs. Guy E. Tripp and Samuel McRoberts of New York City, and Waldo C. Bryant of Bridgeport, Conn., whose terms of office will expire December 31, 1926, and Col. R. P. Lamont of Chicago, Illinois, Col. Frank A. Scott of Cleveland, Ohio, and Col. C. L. Harrison of Cincinnati, Ohio, who were elected at the 1924 elections and who, under the new constitution, will serve terms of four years, expiring December 31, 1928.

In accordance with Art. V, Sec. 2, of the Constitution, each duly authorized local post of the Association shall elect a director for a term to be determined by the respective posts. Col. James L. Walsh, Chief of the New York Ordnance District, was elected by the New York Post as its representative on the Board of Directors.

The newly elected officers and directors of the Association are, all of them, men of high reputation, unsullied patriotism and broad experience. All properly understand the need of adequate industrial preparedness for America.

If there ever was a time when the cause of adequate preparedness needed the championship of men of broad vision and sound judgment, that time is the present. Apostles of disarmament are splitting the ears of the groundlings with their chant; sincere but possibly misinformed zealots are ready to pin their hopes on everything except the lessons of the past; even those who have drunk from the cup of bitter experience seem to have forgotten the cardinal precepts of national security of which they were once firmly convinced.

And so the Association is fortunate in thus securing the services of men who are well qualified to direct its policies and enhance its interests under such leadership. The future augers well for the mission of the Army Ordnance Association.

Who's Who in This Issue

ROCK Island Arsenal, the New York Ordnance District, and the annual reports of the chief of the Army and Navy Ordnance Departments comprise a series of articles which vie in importance and interest with any previous issue of this journal.

This is a Rock Island number of ARMY ORDNANCE. Col. D. M. King, Commanding Officer; Major L. M. Campbell, who is in charge of design and automotive testing; Capt. Geo. W. Outland, Commandant of the 3rd Ordnance Co.; together with Messrs. Hoisington, Forrest, and Peters—all contribute articles of exceptional merit.

Col. King, who is one of the ranking officers of the Department, has had a long and important military career. His great work overseas during the World War and his superb administration of Rock Island Arsenal have added to an already honorable and conspicuous military record

Major Campbell has done much in the development of automotive matériel for the Department. Formerly chief of the Automotive Testing Division at the Aberdeen Proving Ground, he is now filling the important post of Chief of the Design Section at the Arsenal.

Capt. Outland contributes an interesting story on the 3rd Ordnance Co. with which he is on duty at the Arsenal, and in addition he is in charge of one of the manufacturing shops.

Major Harry Hoisington, ORC., is an Ordnance Engineer assigned to the Manufacturing Division and has for a long time been connected with the operation of the Mobile Artillery Shops.

Mr. A. C. Forrest is attached to the Proof and Inspection Department, where he has a long and creditable record. He is in charge of one of the sections of the Department.

Mr. C. R. Peters is a production manager at the Arsenal, and has likewise served faithfully and creditably during a long period. These complete the articles on Rock Island.

In addition, and of vast importance, is the contribution by Judge Gary. A leader of men and an industrial genius of the highest magnitude, Judge Gary knows the need for industrial preparedness. This he reiterates in his article in an eager and convincing fashion. He bespeaks the interest and cooperation of the other gentlemen on the New York Ordnance District Advisory Board.

General Williams, the able and esteemed Chief of Ordnance, needs no word of introduction to our readers. His annual report for 1924 is recommended to all readers for perusal and study.

Admiral Bloch's Report on Navy Ordnance is also enlightening. Admiral Bloch, too, has had a most successful administration of his Bureau. His report is an encouraging account of the very material progress being made by the Bureau of Naval Ordnance.

Professional Notes

ARTILLERY DIVISION

Divisional Artillery Materiel (Wheeled)

DURING the World War, the divisional artillery available for our service was that set out in the table below. These weapons were considered acceptable at that time. It was understood, however, that cannon with a much longer range were very desirable, provided they had at least the same degree of mobility. The maximum range obtainable with elevation permitted by the American carriage was 12,400 yards. The French "75," which was and is regarded as the most satisfactory, had a range of 9,200 yards, while the British "75" had a somewhat shorter range, the range in both cases being fixed by limitations of the carriage.

The 155-mm. howitzer was used as divisional artillery, but it was considered to be too heavy for this purpose, and was used because it was the only howitzer available. A howitzer 105-mm. in caliber was desired for the divisional artillery, to have the same mobility as the 75-mm. gun, the howitzer of 155-mm. caliber being more suitable for corps artillery.

	Type of Carriage	Traverse Degrees	Elevation Degrees	Range Yards	Weight Pounds
75 mm. Gun, M.1897 (French)	Single Trail	6	19	7,450	2,660
75 mm. Gun, M.1916 (American)	Split Trail	45	53	9,650	3,050
75-mm. Gun, M. 1917 (British)	Single Trail	8	16	6,460	2,890
155-mm. Howitzer, M.1918 (Schneider)	Single Trail	6	42	12,270	7,600

Based upon these facts and conclusions of the Caliber Board, work was begun immediately after the war to develop a satisfactory divisional gun and howitzer. As these two pieces were in the same tactical units, and maintained by the same maintenance organization, it was thought that a carriage should be provided to mount either the gun or howitzer. In order to obtain high angle fire from the howitzer, a maximum elevation of 65° was required. The first post-war design then was the 75-mm. gun—105-mm. howitzer matériel, Model 1920. This carriage was of the split trail type, with a maximum elevation of 80°, having the independent line of sight and a total traverse of 30°. The additional elevation was added for possible antiaircraft use. The gun had a range of approximately 15,000 yards, with a 15-pound projectile, and the howitzer 12,000 yards with a 33-pound projectile. An hydro-pneumatic recoil mechanism was used with a variable length of recoil to avoid interference with the ground at high elevations. The trunnions were located near the breech to increase ground clearance in recoil, and equilibrators were, therefore, required to balance the tipping parts. For the protcetion of the gun crew, very elaborate shields were provided. The road speeds considered were those for motor transportation, and required rubber tires, the wheels being 48 inches in diameter. The road clearance was about 14 inches, the same as for the French "75." The total weight of the unit then was 3,660 pounds, being somewhat greater than the divisional pieces already in service. Four of these units were built. Two were submitted to the Field Artillery for service test by the Artillery Board at Fort Bragg, N. C.

At that time, four guns and four howitzers were built, representing various types of construction and provided with two types of breech mechanism. The side sliding block and the rotating block of the Nordenfelt type were used on these cannon. A wire-wound gun and howitzer were provided, as well as guns and howitzers of the built-up construction using ordinary gun steel. In addition, a chrome steel howitzer and gun were provided to try out the use of higher grade steels for cannon, with a view to reduction in weight. It is considered, however, that the higher grade steel is too difficult to obtain in quantity, and the use of ordinary gun steel is preferable.

Preliminary tests of this matériel indicated that the units were too heavy for the mobility required, and that the elevation of 80°, which caused some of this weight, would not be required for a divisional gun. Interchangeability of the gun and howitzer on the same carriage was found not desirable, as the howitzer, which has the greater piston rod pull, established the minimum weight of the unit. A further design was undertaken then of a simpler carriage for each piece. One 75-mm. gun carriage, Model 1921 (box trail) was built. The gun was of the same power as the 1920. The carriage has an axle traverse on an I-beam axle, total of 10 degrees, with a maximum elevation of 45 degrees. A constant length recoil hydro-pneumatic mechanism was used. An equilibrator was required to balance the tipping parts, as in the 1920 model. This unit weighed 2,750 pounds in the firing position. One unit was built and tested by the Field Artillery at Fort Bragg with the 1920 units. Certain modifications were recommended, such as relocation of parts projecting below the trail which might be damaged. Also parts extended above the wheels, which were easily damaged if the carriage turned over. The road clearance of 14 inches was regarded as insufficient. A seat was desired for the brake operator. These changes are being made in this carriage so that it may be used in future service tests. Further, it was desired to have a split trail of the lightest practicable weight so that it might be comparable in mobility with the box trail types.

The 75-mm. gun carriage, Model 1923 (split trail) was then designed. This unit was completed in July, 1924, and sent to Aberdeen Proving Ground for test. It has a gun of the same power, and includes the best features of the previous models. The elevation was limited to 45° and the traverse increased to 42°. More shield protection was provided for the gun crew than in the 1920 box

trail. The road clearance was increased to 19 inches. The standard 56-inch steel-tired wheel was used, as it was considered that the piece would be primarily used in horse draft. The unit weighs approximately 3,200 pounds in the firing position.

One 105-mm. howitzer carriage, Model 1921 (box trail), was built. This carriage is very similar to the 75-mm. gun carriage, Model 1921 (box trail). The axle was curved, however, to avoid the movement of the carriage wheels, which occurs when using axle traverse on a straight axle. The unit weighs 3,000 pounds in firing position. As a result of the test by the Field Artillery at Fort Bragg, the carriage was considered less satisfactory than the 75-mm. gun carriage, Model 1921 (box trail). The curved axle feature did not improve the ease of traverse materially. A redesign of this matériel was considered necessary.

The 105-mm. howitzer carriage, Model 1925 (box trail), was then laid down. The carriage is now under manufacture. The weight of the recoiling parts has been increased by recoiling the recuperator with the gun on a sleigh. The weight of the unit in firing position will be approximately 3,200 pounds, of which 1,500 pounds move in recoil, which is unusually high ratio. The recoil mechanism is of the hydro-pneumatic type, with a constant length of recoil, one cylinder above and one cylinder below the gun. The axis of the bore has been brought nearer the axle. The 56-inch standard steel-tired wheels are used, which will increase road clearance. An axle traverse is provided on a tubular axle. In these units, a drop block was desired, as it permits easier loading. The use of a sleigh extending to the rear of the gun on this carriage will not permit a drop block, so a side sliding block was used and a vertical opening is provided to permit easier loading. A heavy traveling lock is provided between the rear end of the sleigh and the trail. The gun may be retracted for traveling and locked by the same traveling lock.

In view of the number of German 105-mm. howitzer carriages on hand, four carriages were put in condition for service use and turned over to the Field Artillery for test. The howitzers were rechambered to use U. S. ammunition. The test of this material indicates that they are satisfactory for service use, although manufacture appears difficult. The carriages were stable and functioned well. Ranges can be obtained up to about 11,000 yards. These carriages weigh 3,225 pounds in firing position.

In conclusion, the progress of development to date indicates that we have been able to produce new models of matériel of several types which appear superior to World War types in many respects, and especially with regard to range and weight. The problem has now become one largely of test on a service scale; that is, in quantities of batteries or regiments, so that the merit of the new types, as regards ease of manufacture and tactical value, can be determined. It is believed that upon completion of test of the types now under test, or now under manufacture, the Ordnance Department will be in a position to recommend as suitable for manufacture for service test, improved models of divisional guns and howitzers. In view of the importance of divisional artillery, the improvement of the matériel is of the highest importance, and it is believed that the progress of the development since it was begun, in the early part of 1919, has been considerable. Such improvement as may have been obtained has not been due to any revolutionary changes in type or construction, but has been brought about by painstaking improvement in mechanical elements, and a better arrangement of these elements with regard to service and manufacture.

W. C. YOUNG,
Major, Ordnance Dept.

Stockett Line-Throwing Gun

A LINE-THROWING gun of novel and unique design has been designed and patented by John W. Stockett, an employe of the Ordnance Department, U. S. Army.

The gun as designed and patented by Mr. Stockett is a radical departure from the type generally in use in the U. S. Coast Guard Service, especially with respect to the manner of loading the projectile into the gun and the mode of connection between the projectile and the line.

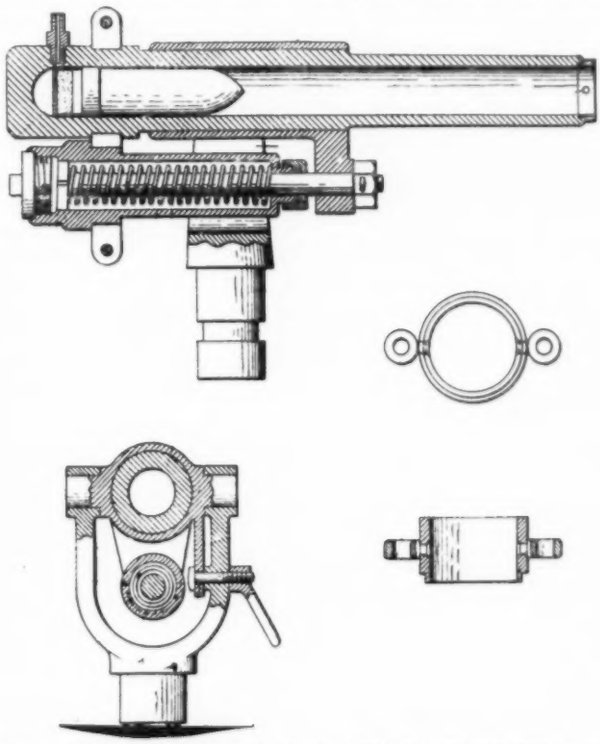


Fig. 1. Diagrammatic Sketch of the Stockett Line-Throwing Gun

The projectile with its propelling charge is arranged as a round of fixed ammunition and is so constructed that it can be used in a muzzle loading gun, and at the same time the round of ammunition is strictly waterproof.

The projectile, in leaving the muzzle of the gun, carries along with it a line ring, that is purposely mounted into a counterbore in the muzzle of the gun. The line, which is attached to this ring by means of a bridle, has no tendency to break, inasmuch as there is no interference between it and the projectile, the projectile does not tumble during flight, as is the case in the older types of line-throwing guns, thus preventing any tendency to break the line.

The gun and mount are so designed that the gun is stable in action, and does not make a back somersault when fired, but returns automatically to firing position. A gun and mount of this design has been manufactured and fired with the most satisfactory results.

New 5-Ton "Caterpillar" Tractor

A NEW 5-Ton "Caterpillar" Tractor has recently been announced by The Holt Manufacturing Company, with factories at Peoria, Illinois, and Stockton, Cali-

fornia. The new model embodies many new and distinct features, tending toward greater accessibility, dependability and economy. The outstanding feature of the new design is unit construction; three units, the engine, transmission and track units, forming the complete tractor.

The motor is a 4-cylinder, valve-in-head type; bore

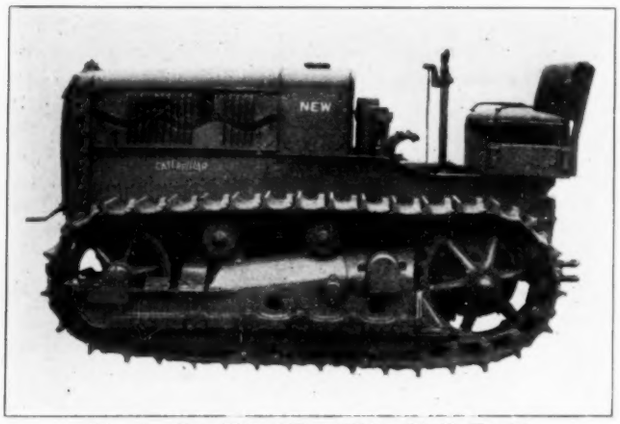


Fig. 2. New Holt 5-Ton "Caterpillar" Tractor

4¾ inches; stroke 6 inches; 1,000 R. P. M.; gear-driven fan and water pump; full force feed lubrication. Special attention has been given to compactness and complete accessibility. Large side plates provide for bearing inspection and adjustment.

The transmission is selective gear type, with three speeds forward and one reverse. Forward speeds are: First, 1.75; second, 3.00; third, 4.25 M. P. H.; reverse, 2.00. In each speed, power is applied to the sprocket with but three gear contacts. All shafts are mounted on heavy duty ball and roller bearings. Steering clutches provide independent, yet positive, drive to each track; no differential is employed.

The entire weight of the tractor is carried on the roller frame through a 3-point spring mounted suspension. The truck frame incorporates marked simplicity in design, yet permits operation of each side to accommodate itself to the inequality of ground surface. A new and unique feature is the drive link and spring construction, which permits the centers of the drive sprocket and track idler to approach each other so that the drive sprocket can slip over the space blocks, should an obstruction gain access to the track unit. The track shoes and rails are cast integral of high carbon steel, specially heat treated. The track shoes are 12 inches wide.

The new model has been designed to meet the exacting demands in the medium power field. While nominally rated at 25 drawbar horsepower, it has a substantial reserve for all conditions.

Two of these tractors have recently been procured by the Ordnance Department for test at the Aberdeen Proving Ground as to their suitability for military purposes.

PICATINNY ARSENAL

Action of Diphenylamine in Smokeless Powder

NITROCELLULOSE, and smokeless powder prepared from it, liberate nitric oxide, NO, upon decomposition. Nitric oxide, on exposure to air, combines readily with atmospheric oxygen, with the evolution of heat and the formation of nitrogen peroxide, NO_2; this latter oxide is a reddish-brown gas, which possesses a very strong and unpleasant odor. The 65° surveillance test is based upon the fact that these red fumes are produced copiously by decomposing nitrocellulose powder. The test involves merely the storage of a sample of powder at 65°C. in an 8-ounce glass bottle until red fumes are seen to develop in the bottle. The presence of the red fumes indicates that the powder has reached an advanced stage of decomposition and the number of days required for the sample to reach this condition is an index of the stability of the powder. If a box, containing smokeless powder of low stability, is opened, the presence of the nitrogen peroxide within can readily be detected by the odor and color of the gas.

It has been found as a result of experimental work that this nitrogen peroxide promotes the decomposition of nitrocellulose to an extreme degree; thus as soon as traces of the gas are formed, these traces react with the powder, and the decomposition, which originally was only slight, is greatly accelerated. The heat evolved from the reaction also becomes greater and greater, until the possibility of spontaneous ignition is afforded. It has also been found that nitric oxide, which is first formed in the decomposition of smokeless powder, does not promote decomposition to nearly as great an extent as does the nitrogen peroxide.

With the above conception of the manner in which nitrocellulose decomposes and the effect of the products of decomposition in accelerating decomposition, it is obvious that in attempting to stabilize smokeless powder two methods might well be employed. First, purification of all constituents, including the nitrocellulose, prior to their incorporation in the powder in order to render the powder more stable intrinsically. Second, adding some constituent to the powder which can combine with the nitric oxide liberated upon decomposition of the nitrocellulose, and thus prevent the formation of nitrogen peroxide fumes or the development of acidity in the powder.

The purification of raw cotton, the boiling, beating and poaching treatments given to the nitrocellulose during its manufacture, and the rigid inspection of alcohol, ether, etc., are steps that are taken under the first method mentioned above for the stabilization of the finished powder.

Much experimental work has been done toward finding an agent which, when added to the powder, will effect a still higher degree of stability than can be obtained by purification of the constituents.

Of a large number of compounds that have been used for this purpose, diphenylamine has been found to be the most suitable. It cannot be considered ideal, however, for, being a strong base, it reacts with nitrocellulose, and, if used in too great amount, will really reduce instead of increase the stability of finished powder. It has been found that 10 per cent diphenylamine in a powder has a harmful effect on the stability, and that 40 per cent will cause spontaneous ignition if the powder is heated to 110°C. for a short time. (Editor's Note: Investigations of the effects of smaller amounts have failed to show any harmful effects of quantities of diphenylamine up to 2 per cent or even more.) The beneficial effect of small amounts of diphenylamine is dependent upon the fact that the increased stability which results from the ability of diphenylamine to react with nitric oxide or nitric acid and hence prevent the development of acidity in the powder, more than offsets the slightly

reduced stability caused by the reaction of the diphenylamine on nitrocellulose.

As stated in numerous places in the literature, the reaction between diphenylamine and nitrogen oxides results in the progressive nitration of diphenylamine. The progress of this reaction has been represented as follows:

$C_6H_5.NH.C_6H_5$
Diphenylamine
↓
$C_6H_5.N.(NO)C_6H_5$
Diphenylnitrosamine
↓
$C_6H_5.N.(NO).C_6H_4(NO_2)$
Nitrodiphenylnitrosamine
↓
$C_6H_4.NO_2.NH.C_6H_4NO_2$
Dinitrodiphenylamine
↓
$C_6H_4(NO_2).NH.C_6H_3(NO_2)_2$
Trinitrodiphenylamine

As a result of this progressive nitration, a powder which has decomposed to any great extent may contain a number of these diphenylamine derivatives. Some of these have in fact been isolated from old smokeless powder, thus proving that the nitration of the diphenylamine does proceed substantially as shown above.

As soon as all the diphenylamine has been used up in reacting with the nitrogen oxides, any additional oxides liberated are free to form nitrogen peroxide which reacts back upon the powder and produces a rapid increase in its rate of decomposition. A visual examination of an old, unstable powder will usually reveal a roughened discolored surface at the ends and edges of the grains, this being the result of the action of the nitrogen peroxide fumes. The serviceability of a powder may be expected to decrease very rapidly after this point in its stability life has been reached.

The deleterious effect of moisture on the stability of nitrocellulose powder has long been recognized. An explanation of this action may be found from a consideration of the chemical properties of nitric oxide. As mentioned above, this oxide combines with the oxygen of the air to produce the reddish-brown gas, nitrogen peroxide. But, in the presence of moisture, nitric acid, instead of nitrogen peroxide, is formed. Since nitric acid is a liquid, it would remain in the powder grain and finally build up to a concentration sufficient to cause rapid decomposition of the nitrocellulose. Since such an acid condition in the powder would be even more harmful than exposure to the red fumes, it may be expected that a powder containing excess moisture would deteriorate more rapidly than one which is dry.

Recent experimental work at Picatinny Arsenal has shown that a nitrocellulose powder of normal stability, which gave a test of 540 days in the 65°C. surveilance test was so reduced in stability by exposure to a saturated atmosphere at 50°C., that, after three months of such exposure, it stood for only nine days in the 65°C. surveillance chamber before red fumes appeared. This illustrates forcibly the harmful effect of moisture on nitrocellulose powders.

G. C. Hale.

ROCK ISLAND

1924 Steel Crossings

THE Rock Island Arsenal has devised a form of steel crossing where vehicle roads cross raliroad or street railway tracks that has been so satisfactory that it is deemed appropriate to publish a description and illustrations of the construction for the information of anyone who may want a high-grade crossing.

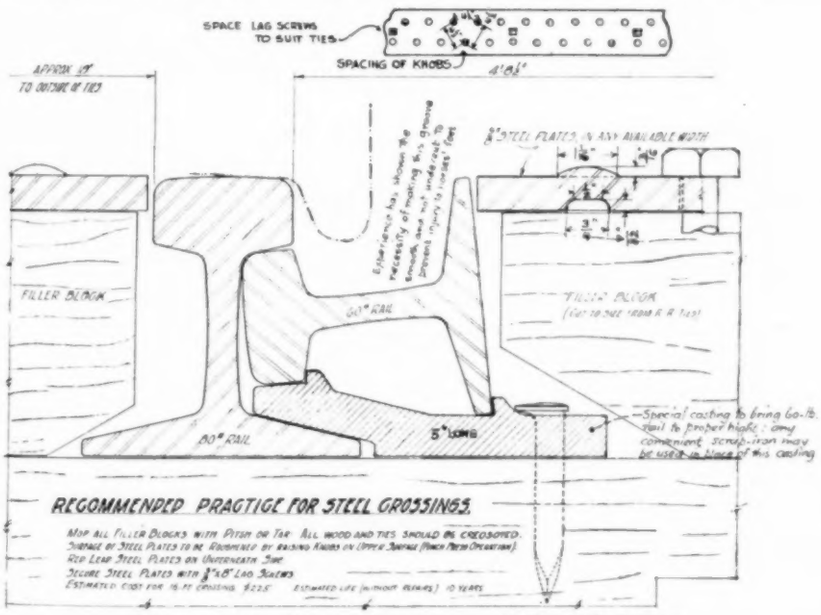


Fig. 3. Detail of the Rock Island Arsenal Standard Crossing

In building steel crossings, the Arsenal is careful to see that nothing but creosoted oak ties are used, and that these are well tamped. Creosoted oak filler blocks fill the space from the tops of the ties to the level of the top of the rails, allowing ⅝-inch for the crossing plate, which makes the crossing flush with the rail. The crossing plates are of ⅝-inch steel, varying in width from five to seven inches.

These plates are run through a punching operation, raisink knobs on the upper surface to prevent horses from slipping on the smooth surface. The crossing plates are held down by ⅝-inch lag screws 8-inches long. The square heads of the lag screws project, but do not seem to injure automobile tires. The steel is painted with red lead on the under surface before laying. The space between the filler blocks is left open for drainage. The cost of a 16-foot crossing is $225; the crossing is designed to last ten years without repairs.

D. M. King,
Col. Ordnance Dept.

WATERVLIET ARSENAL

A 3-inch 15-Pdr. Gun With a Loose Liner

WITH the idea of standardization growing more popular each day, and the means of carrying out this idea becoming more and more practicable, it is not surprising

that certain old and established methods of gun construction are undergoing radical changes. The demand that designs permit quantity production has become an essential requirement. When simplicity and interchangeability are combined with the selection of material that will stand up under working conditions, then the design approaches the ideal.

The idea of a loose liner originated from the fact that

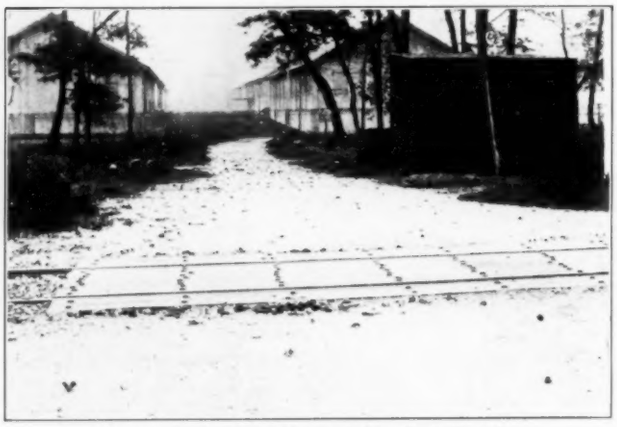


Fig. 4. Rock Island Arsenal Standard Crossing

a great deal of time is lost when a gun has to be taken out of service and sent to an Arsenal some distance away, to have a new tube or liner shrunk in. This method of retubing necessarily puts that particular gun out of use for at least six weeks, whereas, if it were possible to simply withdraw the loose liner, just as easily as a breech block is withdrawn, and insert a new liner (all rifled and chambered), then the gun would be out of commission for only two or three hours. The fact that the loose liner is made with a slight taper, permits easy assembly and removal. It is believed that loose liners might be made interchangeable and shipped out with a completed gun as a major spare part. This procedure might be limited to guns of reasonably small caliber, say, up to 5- or 6-inch, although the general idea might be applied to all calibers of guns and the time required for relining would be very much reduced. The present method of unshrinking and shrinking is, necessarily, a rather long and expensive method. The experiment being made on the loose liner for this 3-inch gun is one of the first steps that the Ordnance Department has made in trying out this idea. At the same time, the value of *auto frettage* as a means of improving the strength and wearing qualities of the metal is also being given a test by making the loose liner from an *auto frettage* forging. It must be understood that the work described in this article is in the experimental stage only.

In the design of this 3-inch-15 pdr. with a loose liner, it is believed that the effort to combine the points mentioned in the first paragraph will result at least in securing valuable information for future gun construction. Gun No. 35 (3-inch-15 pdr., M. 1917) was sent in from the field to be retubed, having already been fired a considerable number of rounds. It was decided that this type would be a suitable one for trying out the idea of a removable liner. This type of gun is made up of a jacket and a tube; ordinarily when it has been fired so long that it has lost its accuracy the tube is removed by unshrinking and a new tube shrunk in, rifled and chambered and then sent out to the service as good as new.

Originally, the strength of the tube of this particular gun had been calculated as a "one piece tube." Now, to bore out the rifling of the old tube to a sufficient depth to permit "dropping in" of a loose liner, brought up the question of whether the factor of safety of the "relined tube" would be great enough to permit firing. Here is brought up the point of selectnig "the material that will stand up under working conditions." The answer to this question was an "auto frettage" liner. By means of *auto frettage* (which was done at the laboratory at Watertown Arsenal) it was possible to get material that it is calculated will stand up under the firing strains.

Assuming then that the question of the material is settled, the other two points, simplicity and interchangeability, will be taken up. This removable liner was made at Watertown Arsenal. It consisted of a simple cylindrical forging which had undergone *auto frettaging* in the bore, which was considerably smaller than the finished bore will be. It was found that, first of all, a true bore had to be obtained before final machine work could be started. The *auto frettaging* had been done in progressive steps that left slight irregularities in the original bore of the liner. This true bore was made a fraction of an inch less than the finished bore for the reason that further laboratory tests were to be made at Watertown Arsenal on the tube and liner after they had been assembled. The next step in the machining of the liner was to turn the liner to a given dimension, which, instead of allowing for shrinkage, as had been the previous practice, it actually allowed for a .002-inch clearance when assembled in the tube.

The process of machining the two members, tube and liner, is not of special interest here. But it was laid down in the design of this gun that positioning keys would be used at both breech end (at the origin of the rifling, which is about 40 inches from the breech face) and at the muzzle. The keys were integral with the liner at the breech end, and at the muzzle, end key ways were cut in both liner and tube and a special key, as shown on accompanying sketch, was used. The cutting of the key way at the muzzle end did not offer any particular difficulties for the reason that they were so near the muzzle that this could readily be done. Neither did the cutting the keys integral with the liner offer any particular difficulties. But getting into the old tube and cutting the key ways in this member at a distance of 40 inches from the breech face was a very difficult job.

A deep key-seating device, which was on hand at this Arsenal, was modified, as shown in Fig. 5-A, for cutting the key ways at the breech end of the old tube. The principal modification on this device consisted of an eccentric adapter, which was of such a design as to give the cutter a proper depth and guide it along the same taper as the bore. With this device, the key way was cut in one progressive operation. This cut was made in twenty minutes. After cutting one of the key ways, the indexing head was rotated 180° and the second key way was cut.

The device mentioned above was not needed for cutting the key ways at the muzzle end because these were actually at the muzzle. A loose key was made, as shown in Fig. 5-B, which is of rectangular cross-section with a round positioning stud. This key was inserted in the key way in the old tube and the positioning stud held it until the loose liner was dropped into place. The key way in the loose liner is 1-inch longer than the key itself. This extra length of the key way permits the loose liner to extend in the muzzle direction without

shearing the positioning stud on the muzzle key. The purpose of the keys at the muzzle and breech end is simply to prevent the liner from rotating, due to the thrust exerted by the projectile traveling down the bore.

A. H. SKINNER,
Captain, Ordnance Dept.

Extractors for Guns Having Drop Blocks and Side Sliding Blocks

NO little trouble has been experienced in having extractors breaking in guns with drop blocks and side sliding blocks. The design has been thoroughly studied, with a view to improving these extractors. The opinion has been finally reached that the trouble lies in one or two places: (1) either in the selection of proper material, or, (2) in the proper heat treatment, and not in the physical design of these extractors.

For the purpose of refreshing the memory of those not familiar with the operation of these extractors, a brief outline of the working principle is given. These extractors are of the so-called "rolling extractor" type. That is, the two trunnions at the base of extractor slide in a groove so designed that when the block has been opened sufficiently far to "unmask" the base of the cartridge case, the extractor is rotated to the rear. During this rotation, the "lip" on the free end of extractor which has been normally resting behind the rim of the cartridge case, engages the rim and pries the empty cartridg case slightly to the rear. The grooves in which the extractor trunnions roll are so designed that the empty case is uniformly accelerated to the rear; by this motion the case is normally extracted clear of the chamber and the breech recess, leaving the gun clear for the next round. The fact that the breech block slides across the base of the cartridge case before this prying action takes place does not necessarily cause the case to be loosened from the walls of the powder chamber, so that the extractor has to not only accelerate the empty case (which is at rest), but also has to loosen the contact between the walls of the powder chamber and the brass cartridge case. Even with a properly designed cam to give accelerated motion to the case, there is considerable stress on the lip of the extractor.

In this type of extractor it will be seen that there are two critical points that have to be given particular attention in both design and in heat treating: (1) The "lip" that engages the rim on the base of the cartridge case is necessarily of a very thin cross-section. This point has to be strong enough to withstand the load necessary to pry the case out but can not be brittle; (2) the trunnions that roll in the grooves have to be sufficiently hard so that they do not "pick up."

During the war, contracts for Ordnance material were placed at Government Arsenals and also at commercial plants capable of manufacturing guns. The material was supplied from various sources. Ordnance inspectors were stationed at all plants where guns were manufactured and were charged with the proper inspection of all material entering into the manufacture of a gun. Examples can be given where, during the war, detail drawings and bill of material differed as to the class of steel for certain parts. With this discrepancy in existence, at the time when large quantities of stock were being purchased, it may explain the fact that at this Arsenal there is in the stock room a large quantity of drop forgings for extractors, listed as low carbon alloy steel, that, by chemical analysis, do not show up to be such. This being the case at one Government establishment, it probably happened at other places. It is easy to see how disastrous it would be to give a high carbon alloy steel a case hardening in order to make both the lip of the extractor and the trunnions meet certain desired requirments.

There seem to be two steels that might give satisfaction, one a low carbon alloy steel, with a prescribed case hardening to a given depth, the other a high carbon alloy steel given a treatment that would bring it up to the required hardness and toughness. There are advantages that might be claimed for using either of these classes of steel. From the manufacturing standpoint, either steel is acceptable. But, due to the fact that one of the critical points in the design of these extractors is the thin "lip" on the free end, it would seem that a heat treatment might be more satisfactory in the long run than a case hardening. For this latter reason, it would seem desirable, (1) to secure positively a high carbon alloy steel, and, (2) then give it a definite heat treatment.

A. H. SKINNER,
Captain, Ordnance Dept.

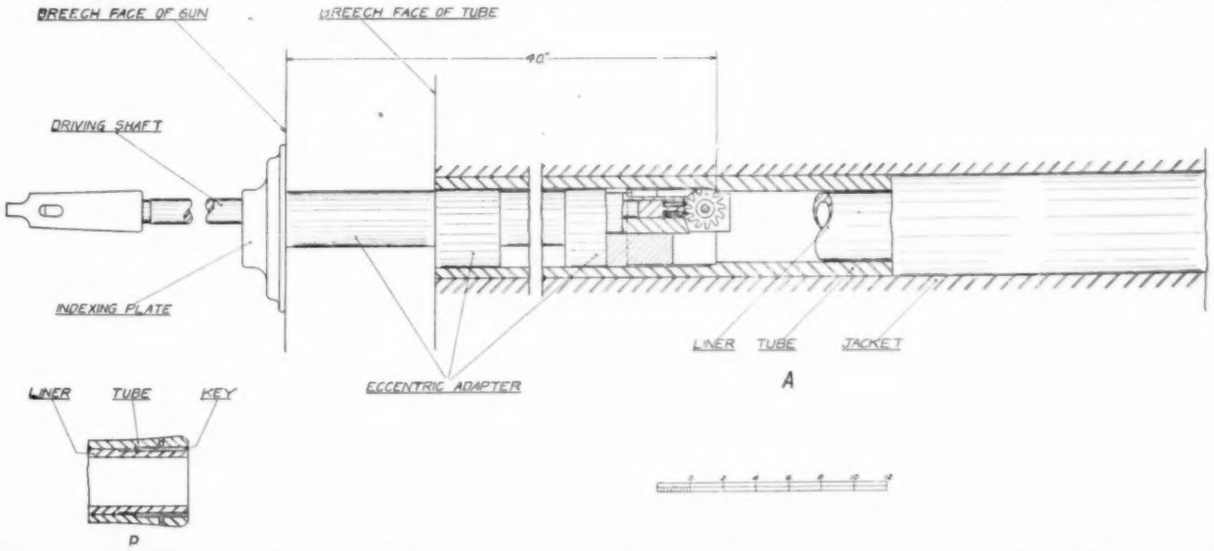


Fig. 5. A. Key Seating Device Modified for Cutting Key Ways at Breech End of Tube. B. Loose Key with Positioning Stud to Prevent Liner from Rotating

Book Reviews

Napoleon: An Outline. By Brig. Gen. Colin B. Ballard, C. G., C. M. G. New York: D. Appleton and Company. 1924.

BOOKS on Napoleon are quite common and any student of military history is doubtless familiar with several. As a rule, however, the majority of books on Napoleon, if found to be interesting, are lacking in authenticity, and if they are technical enough to be of military value they are usually too technical for the general reader. The campaigns of Napoleon have been told time and again, and, in military text books at least, are generally well furnished with maps.

General Ballard's book on Napoleon meets the popular demand for a complete and concise appreciation of the military genius of Napoleon, so that the man himself, as well as the history and strategy of his campaigns, can be readily understood by the non-military reader. The book contains 26 maps that have been prepared for this work, and they serve to make the narrative perfectly clear, although the narrative itself is a model of clear and concise reasoning.

General Ballard is well qualified for the preparation of this outline, as he was Professor of Military History at the Staff College of the British Army, and for more than 25 years delved in Napoleonic literature. The author is a great admirer of Napoleon, yet, at the same time, he is not so blind but to readily see the faults of that prodigy. The presentation of the facts in this book and the logical conclusions drawn from these facts are models of clear thinking and writing.

The book is divided into four parts: Part I being called "The Adventurer"; Part II, "The Man of Destiny"; Part III, "The Man Against Destiny"; and Part IV, "Dramatis Personae."

Part I deals with the early days of Napoleon, including his early family life. The discussion in this part also takes in Napoleon's early campaigns down to his Egyptian disaster.

Part II covers the period preceding and following Marengo down to the battle of Wagram. There is a very interesting chapter on "The Straits of Dover," and the elaborate land and naval preparations which Napoleon made for the invasion of England.

Part III shows the decline of Napoleon, including the Russion debacle and the events leading up to the 100 days at Elba. The battle of Waterloo is given in detail and with striking clearness. The last chapter of this part shows Napoleon at St. Helena with some original comments on the part of the author regarding the historical value, or lack of value, of the "Napoleonic Legend."

Part IV deals with Napoleon's wives and his numerous affairs of the heart, together with a very good description of the Napoleonic family and the contemporary "Court of France." One chapter is devoted entirely to Napoleon's Marshals with a short biographical sketch of each.

The author's method of presenting his outline is admirable. For example, he compares Napoleon's system and method of campaigning on interior lines with that of the great Von Molkte, as Von Molkte is accepted as the first exploiter of the theory of exterior lines. The Napoleonic theory was a one man show, based upon the pronoun "I," as Napoleon stated in his maxims, "I see only one thing," "I am always on interior lines," "I always concentrate superior forces at one decisive point," and as he stated in one of his confidential moments, "The spot upon which I stand is the most important on the globe." Napoleon "out-Caesared" Caesar when it was necessary to be everywhere at once. He made every supervision of previous preparation, decided the moments for concentration in advance, where, how and when to keep his reserves, he himself must see the main body of the army and make the momentous decision for the decisive blow. He "out-Prussianed" the Prussians in wanting his army to be a perfect machine, drilled and disciplined, but worked by one man.

The author states that one man can control perhaps 40,000. Napoleon, who was a genius, could control perhaps 100,000, but no human being could control more, so that when he had half a million men in Russia, he had big detachments under commanders afraid to use their own judgment and who sat wating orders which failed to come or came too late. The author notes that the smaller Napoleon's army, the more brilliant his success.

On the other hand, Von Molkte placed his forces on the rim of the wheel and made converging attacks toward the army on the hub, not that he had a theoretical preference for this method, but it was forced upon him by concrete numbers, such as in 1866 when he had a quarter of a million of men spread over many miles of ground with personal supervision impossible. Von Molkte invented the modern staff to keep him in touch with scattered units, to collect and compile reports, to study movements of the enemy, and in order to carry out his general policy, to issue orders to subordinate commanders.

If the opposing armies are fairly equal, this method frustrates Napoleon's method of concentrating superior forces for the decisive blow, as a superior force at one point means an inferior force at another.

General Ballard shows that in Von Molkte's two campaigns he was opposed by indifferent generals who stood on the defensive. It is impossible to say what might have happened if he had tried to swallow a Napoleon instead of the Austrian commander, Benedek. Likewise, Napoleon was fortunate in his first campaigns that he did not thrust his head into the jaws of a Von Molkte. At Waterloo he thrust himself between Wellington and Blucher, so that he could not concentrate superior forces at the decisive point because they would not let him. The author believes that Napoleon's system has passed away forever, as modern conditions require decentralization and initiative.

Both commanders based their campaigns upon four

phases, preparation, concentration, maneuver and decisive blow. The difference between them lies in the concentration; Von Molkte concentrated on the battlefield, Napoleon before contact with the enemy.

One interesting chapter in the book contains the only authentic data which is on record as estimating the power of the weapons in use so long ago. This table is as follows:

	Point-blank	Extreme range
Musket	270 yards	1,348 yards
Guns, 8-pounder	540 "	3,372 "
" 16 "	540 "	3,541 "
" 32 "	540 "	4,046 "

These were the weapons which Napoleon was in charge of at Toulon, which is the first place he acquired a reputation. The author states that it is not explained what "point-blank for the musket" means but goes on to say that fire was rarely opend at anything over 100 yards and that we may guess that the average marksman might hit a battalion column at 200 yeards, a hay stack at 50 and a single man at 30.

In this connection the author shows that Lord Nelson's idea of the proper range for a British gunner was something under 50 yards, and the proper target a battleship. Under these conditions, it is difficult to score a miss, sights only waste time, and the great thing was to fire two broadsides to the enemy's one.

The author, in describing Napoleon at St. Helena, discusses the question of whether he is a great man or not. In its simplest sense, greatness implies only size. There have been great sinners, as well as great saints. He concludes that Napoleon is called great because he imposed his will on more human beings than any man in history. At first, people followed him because it was to their interest to do so. Afterwards, when it was not to their interest, why did half a million men take up arms for the invasion of Russia? Crowds have been drawn to the Crusades by religious beliefs; to the banners in the World War by patriotism, but of all those who entered Russia, there were few who wanted to go, and probably none who knew any reason why they went except that Napoleon willed it.

Men followed him when there was no more loot or glory to be won. They clung to him across the frozen desert of Russia, and in the retreat from Waterloo, the last square to break its ranks was the one in which Napoleon stood. As the author states, the man in the ranks is not a model of wisdom in every respect, but he is a mighty shrewd judge of his own commanding officer. No lying bulletin can throw dust in his eyes, no advertising swash-buckler can pose as a hero. In the judgment of the old guard, Napoleon must have been a great man as they spoke of him as "L'Homme."

The book abounds in local color and intimate touches. For instance, Josephine usually has received more popular sympathy than Napoleon by reason of his treatment of her. The author, however, shows in the present outline that this sympathy has been very much misplaced, as the part played by Josephine is not particularly enobling or unselfish.

It is believed that this volume is one of the most readable books on Napoleon and his campaigns for both the general reader and the military man that has been published in years.

Famous American Naval Officers. By Charles Lee Lewis. Boston: The Page Company. 374 pages. 24 illustrations. $2.00.

IT was in 1843 that the first collection of lives of American Naval Officers was compiled by John Frost. This early work included twenty-one distinguished leaders and the author (apparantly setting the fashion for all subsequent compilers) acknowledged that only the lack of space and material prevented his including other equally meritorious commanders in the single volume. Since then, much water has flowed under the bridge; ships have been fought to victory and to a watery grave; seafaring men have forced isolated peoples into the community of nations and pushed forward the frontiers of chartered navigational waters from the North Pole to the Antarctic Continent; the secrets of meteorology and oceanography have been ferreted out and freely published to the commercial world while the transition from sail to steam was still in its infancy; and in the meantime, four wars have been brought to a successful conclusion.

Our sympathy goes out to any one who faces the task of selecting twelve outstanding leaders in the various activities of the Navy up to the present time. We may as well say at once that Charles Lee Lewis, in his "Famous American Naval Officers," has performed this task with credit to himself. He has selected the single ship fighters, Paul Jones, Stephen Decatur and David Porter; the master seaman, Isaac Hull; the squadron commanders, Oliver H. Perry, Thomas Macdonough, David G. Farragut and George Dewey; the preeminent diplomat, Matthew G. Perry; the touchstone historian, Alfred T. Mahan; the Arctic explorer, Robert E. Parry; and the strategist and administrator, William S. Sims.

The life stories are written in a straightforward, entertaining style, free from bombast, reliance being placed on stirring facts simply told, rather than on perpetuating dubious legends. The work is such that the enthusiastic youth, having once dedicated himself to these leaders, cannot, on arriving at the period of cynicism, cavil with the statements he once accepted and transfer his admiration elsewhere.

We must record, however, that the survey under review has omitted three important phases of naval activity dominated by leaders of exceptional merit. Privateering—in the days of the Revolution an entirely legitimate enterprise—brought the struggling Colonies many a sorely needed cargo of supplies and furnished sea tales of fights against great odds, matched only by the exploits of the regular Navy. The life of Commodore Thomas Truxtun, who fought through the Revolution as a Privateersman, would have given an interesting sidelight on this abandoned phase of naval warfare.

The originator of the idea of the establishment of a weather bureau, the one who first applied the study of winds, storms and ocean currents to the benefit of all mariners, was Commander Matthew Fontaine Maury. While still in the midst of his work, he was honored by the crowned heads and many scientific societies of practically every civilized nation. The sailing routes which he first prescribed between all important sea ports, saved commerce millions of dollars annually and most of the recognized commerce lanes for sailing vessels to-day are where he originally laid them down. He cannot well be overlooked.

The investigational cruises of the British ship *Beagle* would still be well known to-day for their rich contribution to the world's scientific knowledge, even if Charles Darwin had not shed an added lustre on them by writing his "Descent of Man" and andvancing the theory of evolution subsequent to his joining the ship and completing a cruise. Our Navy also had an indefatigable explorer and contributor to scientific knowledge in Rear Admiral Charles Wilkes, whose discovery of the Antarctic Continent and other carefully conducted explorations give him a secure place among the Navy's distinguished leaders.

The present volume is one of a series of boy's books and thus represents an opportunity to get excellent reading at a moderate price. There is nothing juvenile about it except the cover. The author has treated his subject seriously and merits serious consideration. A carefully prepared index and bibliography are appended. We venture to predict that if the work were enlarged by the three characters mentioned, handled in the same style and bound in library form, it would immediately be recognized as a standard, authoritative work.

The Economy of Human Energy. By Thomas Nixon Carver. New York: The Macmillan Company, 1924. xiii+287 pp. $2.50.

PROFESSOR Carver has written this small volume on the fundamental thesis that economic questions are questions of human energy or manpower. In a very readable manner he discusses a wide range of subjects which are brought into relation by this thesis. While few of the ideas developed will be unfamiliar to the student of economics, their presentation will be stimulating to the thoughtful layman and especially so to those who are interested in the seething whirl of post-war economic developments.

The wide range of subjects touched upon and the brevity of treatment of each subject results in a condensation of statement that at times appears almost dogmatic. A single text which discusses in a brief compass questions of population, citizenship, thrift and the standard of living, the economy of food, the economic value of moral qualities, civilization, the economic cost of immorality, new sources of energy, organization as a means of economizing, production vs. predation, the importance of serving and other subjects, can do no more than present the salient outlines of the writer's argument. This is done by the present text with great skill and the book is one which the general reader will find of interest and value.

A paragraph from Professor Carver's "Summary and Conclusion" will serve to indicate his method of treatment and syle:

"From this outline it will appear that the word Economics covers much more than is commonly assumed. That truthfulness is a labor saving invention, or at least a great economizer of social energy may appear as a novel idea to those who have never thought of it before. And yet, nothing could be clearer. A lying community cannot work together effectively and must, in the long run, lose ground in competition with a community where general confidence prevails among the citizens. Respect of property rights works in the same way. Even they who oppose private property do not like to live in a community where property in some form is not secure. They would leave such a community, if for no other reason than because there would be no men of enterprise and business energy to support a population to whom they could preach against private property. Inherited property, on the other hand, is a source of some waste in human life and energy in that it enables men to live without work who would otherwise have to work. On the other hand, it is doubtful whether men in the ordinary walks of life would work as hard to accumulate wealth, which is a great social advantage, if they could not leave a part of it at least to their heirs. From this point of view it is a means of economizing and utilizing energy. Does it occasion enough waste to overbalance this economy? This is the only phase of the question of inherited wealth which is worth discussing."

Graphic Statistics in Management. By William Henry Smith. New York: McGraw-Hill Book Company, Inc., 1924. 360 pages with Charts and Diagrams. $4.00.

THERE are three distinct ways in which quantitative facts may be presented. First, as a plain statement of fact; second, as a statistical table; third, as a graph. Each has its peculiar advantges. The latter, or graphic presentation, however, is being increasingly resorted to because of its special merits. These special mrits are due primarily to the relationship which lines or pictures indicate and the ease with which this relationship can be grasped mentally.

It is interesting to note that the author in his introductory chapter points out that graphs are not suitable for representing all forms of data—an admission which indicates the whole subject is treated with sound judgment. Also, in a decidedly practical manner the methods of gathering statistics are discussed. Since obviously a graph is of little use if the data are not dependable, this departure from the ordinary books on statistics will appeal to the business man who not only wants to know how to construct graphs but also the best way to obtain the basic information.

After discussing the methods of obtaining basic information, the author outlines how to choose the type of chart to be used. Will pictorial charts, bar charts or line charts best suit the problem? Each is carefully analyzed and several simple rules given to enable the beginner to make the right selection. Numrous illustrations are inserted, most of which are actual reproductions of charts successfully used by the government and commercial firms. Special chapters are devoted to map charts, flow charts, Gantt charts, etc., in which the advantages and disadvantages of each are fully discussed.

Another important section of the volume explains to business men how they may correctly interpret from properly constructed charts economic or other conditions in relation to their own business management. Throughout, the practical value of chart construction is kept in the foreground. The constant aim is to help the business man understand what others have done in his field and to establish a system of statistics which will give a clear picture of requirements, production and sales in his office, resulting thereby in a higher degree of business efficiency. It is essentially statistics in management.

Unlike many books on statistics the text is not a plea for the adoption of any particular system. It is readable, practical and to the point. Its appeal is necessarily made to the beginner and if there is any adverse criticism to be offered it is in the fact that the section devoted to methods of gathering basic information is too condensed.

Labor Attitudes and Problems. By Willard E. Atkins and Harold D. Lasswell. New York: Prentice-Hall, Inc., 1924. 27 Chapters. 512 Pages. Illustrated.

ABOUT the middle of the eighteenth century, machinery driven by mechanical power began to develop and the age of the skilled handicraftsman was at an end. In England, the change wrought by the advent of the machine was of such importance that the whole economic life of the nation was modified and the "Industrial Revolution" appeared as the result of man's improvement of the means of production. Since that period, the machine has steadily increased its field of usefulness with natural displacement of men by machines. Such a condition naturally arouses the antipathy of the man for the machine and forms the background for the bulk of the industrial disputes of the present day. The men who did the work before the machine was introduced will not readily consent to the withholding of a livelihood because of a more efficient instrument of iron.

The conflict of man and the machine has led to distinct class consciousness on the part of the worker. Unions for the protection of rights have been formed. We have even seen a Labor government in England crystallizing the political aspect of the workers' attitude toward society. Our own politicians cater to the organized power of the working masses, and often stand or fall on the response of labor at the polls. In its turn the public often feels the clash of the disputes of labor and capital and endures hardships because a certain group of workers has exercised the constitutional right of quitting work to enforce its side of the dispute.

Class consciousness and organization have developed for the worker a definite and important place in the society of an industrial age. It is thus of considerable interest to the student of economics to inquire into the attitudes and aspirations of the group as a whole and to analyze the modern tendencies of labor in its relation to the authors of this volume. After a general view of labor problems and attitudes as a general proposition, the specific problems of various groups of workers, including the coal miners, the steel workers, agricultural workers, clothing workers, casual laborers, and unskilled women operators, are next discussed. The transition is then natural to the treatment of the position of the working class in industries where the machine has so materially altered production methods. In this section is included an interesting chapter on unemployment as a factor in modern life and the struggle of society to limit its extent and effect. Standards of living as motivating forces in the struggle of the workman for a betterment of his status are next treated. Then follows considerable treatment of the struggle of the workman for what he has been able to secure through labor unions, in which, in particular, the aims and ideals of the unions are sympathetically and fairly treated. Lastly, there follows a discussion of the interests of the public both in protecting labor and in preventing the excesses which labor might exercise if allowed unbridled license.

This work is intended as a text-book for college use and includes at the end of each chapter pertinent questions covering the subject matter as well as references to other works dealing with various phases of the problem. As a whole, the book forms an interesting and sympathetic exposition of labor in its relation to society and contains much of value for the factory executive as well as the student of economics for whom it was intended.

Oil Engines. By A. L. Bird, New York; E. P. Dutton & Company. 1924. 103 diagrams; 276 pages.

THIS book considers oil engines from a general viewpoint and after reviewing the subject from the historical and development period takes up various operating principles, the combustion fuel, results of tests, mechanical details peculiar to oil engines and concludes with a chapter that considers the present position of the oil engine and its probable future development.

While of a general nature rather than being confined to one type, the book is of great importance, for it deals with a class of power now receiving much attention in the United States, the development of which is being given the serious attention that it should have had years ago.

The commercial application of the oil engine in large units has to date been on ships and many of those in use for this purpose are illustrated and described. Brief mention is made of the effort to adapt this type of engine for rail service.

From the types described it is apparent that on account of the great weight per unit of power, the application of the oil engine to automotive vehicles is far from realization until some way is found to reduce weight.

The adaption to railroad service is not affected by weight and it would seem that the time is now here for serious study looking to the application of oil engines to replace steam locomotives. A more general application is largely dependent upon the development of a successful transmission for high powers.

The author concludes his book with a tabulation showing the range of thermal efficiencies of various forms of engines, the range being from four per cent for the simple steam engine to the forty per cent possible with the "Still" type. A glance at this table shows the enormous savings possible from the use of the oil engine where it can be adapted with its present limitations.

David Wilmot. By Charles Buxton Going. New York: D. Appleton and Company, 1924. An illustrated Biography. 40 chapters, 771 pages. $6.00.

ON August 8, 1846, there was sent to the Speaker's desk in the House of Representatives an amendment to the so-called "Two Million Bill" proposed by the President for the purpose of supplying $2,000,000 to negotiate the treaty of peace with Mexico. This amendment was the culmination of years of party strife over the extension of slavery into new territories acquired by the United States and was the first enunciation of the famous Wilmot Proviso which afterwards became the thirteenth amendment to the Constitution of the United States. The free soil campaign of 1848 and the republican party of 1860 were based essentially on this short pronouncement of David Wilmot in 1846, and certain authorities have classed it as the most statesmanlike declaration arising out of the territorial annexations following the Mexican War and the policy on the extension of slavery in connection with these acquisitions. The Wilmot Proviso was expressed in the following words:

"Neither slavery nor involuntary servitude shall ever exist in any part of said territory, except for crime, whereof the party shall first be duly convicted."

It laid the stage for a bitter fifteen year political conflict which had only one solution—the final arbitrament of arms.

We read much in our books on American history of the

famous Wilmot Proviso, but we seldom see a reference to the author of the great principle. Mr. Going has decided that the life of the man who, in the words of Douglas, "raised the Wilmot Proviso tornado, and Lincoln swirled up on it," should be interesting reading for the student of American history, and has provided in one volume a scholarly account of the life and work of this Calhoun of the North.

As a matter of fact, there were few important events in the critical period from 1845 to 1865 in which Wilmot did not have an important part. His influence was variously expressed in the national legislature, at the conventions of the free-soilers, and among the common people of a tense period. Most educated Americans know vaguely that his place is among the great statesmen of the country, but until we read Mr. Going's account of his life we are unable to gage the extent of his greatness. While the Proviso is his best claim to fame, it is also surprising to note the various other activities which reflected credit on his abilities and indicated his prestige. From many activities, we can only note, in passing, a few. He had an important part in the organization of the Smithsonian Institution and in the assurance of Lincoln's nomination in Chicago in 1860. He served brilliantly in the House and the Senate, and as a judge in the first U. S. Court of Claims. He fought almost singlehanded for his principles in a pro-slavery period and enjoyed the triumph of writing in 1856 the first Republican national platform.

The author has ably achieved his purpose of bringing before us "a complete picture of David Wilmot as a man and a statesman," thus restoring "to the canvas of American history the living figure of one of the most intense personalities in the great free-soil struggle which culminated in the Civil War."

The Story of Early Chemistry. By John Maxson Stillman. New York: D. Appleton and Company, 1924.

IN this day of "Outlines" and "Stories," such as H. G. Wells' "Outline of History," Professor Thompson's "Outline of Science" and Van Loon's "Story of Mankind," it is encouraging to read a book on chemistry which tells the story of chemical knowledge and science from the earliest times to the close of the 18th Century in such a way that it will be fascinating to the average reader and at the same time will be a source of valuable historical information to the professional chemist.

Professor Stillman, late Professor Emeritus of Chemistry, Stanford University, is well qualified to tell this story, for much of his life has been given to the history of chemistry, and for many years he has taught the subject to small classes. Previous to the present book, he had written a number of shorter articles of more or less popular interest for such publications as "The Popular Science Monthly," "The Scientific Monthly," "The Monist" and several other publications.

In the present book he has carried along in a parallel development from the earliest known beginnings of the history, on the one hand, of the chemical arts, and on the other hand, of chemical thought and theory, completing the work with the downfall of phlogiston, or fire theory.

The book starts with the practical chemistry of the ancients, and quotes certain portions and extracts of the earliest known manuscripts dealing with chemistry. The author outlines the theory of the ancients with regard to matter and its changes, and gives considerable information regarding the early alchemists and their mystic theories.

This is followed by a discussion of the chemical knowledge of the Middle Ages, including chemistry of the 13th, 14th and 15th centuries.

Two chapters are devoted to the 16th century with its progressive trend of chemical development. The latter part of the book deals with the 18th century and the rise and fall of the phlogiston theory. This remarkable theory attempted to explain and to correlate the phenomena of combustion, oxidation and reduction in a relatively simple and comprehensive manner. Until modern chemistry these phenomena were very difficult to explain, due to the fact that the constitution of the air in which combustion takes place was unknown, oxygen not having been discovered by Priestly until sometime later. This theory may be best understood by stating that all substances give off phlogiston readily instead of saying, as we do, that they take up oxygen readily.

The latter part of the book devotes a chapter to the development of the chemistry of gases. This development chiefly contributed to the overthrow of the theory of phlogiston.

A chapter is also devoted to the early idea of chemical affinity, and another chapter to the chemical revolution which took place in chemical theory, thought and development as a result of the work of Lavoisier, the effect of whose work extends down to our present day.

The author, in compiling his history, has based his outline on the development of certain elementary substances, so that there is a connected chain of thought on the history of the more important elements, such as iron, phosphorous, copper, potassium, etc. While this has facilitated following the chemical history of substances, it has made a little confusion with regard to the history of men who are connected with chemical history. The book is in no sense a biography of eminent chemists, although considerable information is given with regard to all men who are of real significance in the growth of chemical science. Emphasis has been placed upon the discoveries and speculations that have made a decided impress on the growth of chemical science.

The book contains a great many quotations from ancient and modern languages with valuable references, so that the scholar or the scientist who is interested enough can verify for himself the accuracy of the translation. A valuable bibliography of the works consulted in the preparation of the book, not including journals or proceedings of standard societies, is appended.

The book contains a great many of the early chemical formulas, and it is quite evident that the formula used in mixing the witch's brew, as told by Shakespeare in "Macbeth," was quite similar in ingredients to the current recipes of the time.

The Story of Early Chemistry is extremely readable and should be enjoyed by anyone who is at all interested in historical research or who has ever been inclined to take the slightest interest in chemistry. In this day and age of the world, this embraces nearly everyone, as the present day application of industrial chemistry is widespread and far reaching.

Reserve Corps Notes

Items of Interest to Members of the Ordnance Section, O. R. C.

Edited by Major John A. Brooks, Jr., Military Personnel Section, Office of the Chief of Ordnance

THE new regulations for the Officers' Reserve Corps are still in the hands of the printer. After their publication and distribution it is expected that it will be necessary for the War Department to determine and publish various policies and provisions relating to their administration. As soon as this has been done all information of interest to officers of the Ordnance O. R. C. will be published in this section of ARMY ORDNANCE. This will include definite instructions regarding appointments and promotions.

IT is expected that a meeting of Corps Area Ordnance Officers will be held in Washington during the latter part of January. One of the purposes of this meeting is to arrive at a uniform method of administration of Reserve Activities in the several Corps Areas. Plans for procurement, assignment, training and promotion of Reserve Officers will be discussed. The results of this meeting should, therefore, be of much interest to officers who are assigned to duty with troops.

MANY Reserve Officers, as well as applicants for a Reserve Commission, do not have a clear understanding of the distinction between "Special Service" and "Service with Troops." This distinction is important not only because the character of examination for appointment and promotion is different, but the duties are not of the same nature and different offices have jurisdiction over assignment, promotion and training.

Officers who apply for "Duty with Troops" are in general placed in what has been known as Territorial Assignment, or T. A., Group, and are assigned to the Corps Area in which they reside. The Corps Area Commander then assigns them to one of the tactical units under his command. The majority of these officers are of the grade of Lieutenant and Captain, and are assigned to Ammunition, Depot or Maintenance Companies. They are trained at such times and places as the Corps Area Commander may direct, and he prescribes the character of training, subject to general instructions from the War Department.

Officers who apply for "Special Service" are placed in what has been known as the Branch Assignment, or B. A., Group. These come under the assignment jurisdiction of the Chief of Ordnance. Their qualifications are carefully considered and they are assigned to the Office of the Chief of Ordnance or to the nearest Arsenal, Proving Ground, District Office or to other activity under the control of the Chief of Ordnance for which they are properly qualified. They are trained under the direction of the Chief of Ordnance.

The general policy governing the training of Ordnance Reserve Officers under the assignment jurisdiction of the Chief of Ordnance will be discussed in a later issue.

MANY officers assigned to Ordnance establishments are confused by the fact that they receive some communications through Corps Area Headquarters and headquarters of tactical organizations within the Corps Area. This is in accordance with existing War Department orders which state that *all* Reserve Officers are under the *administrative* control of the Commanding General of the Corps Area in which they reside. Each Corps Area keeps a record of all Reserve Officers of all branches who live within the Corps Area, and communications affecting these officers are required to be sent through Corps Area Headquarters. In order to maintain personal contact and to be of assistance to Reserve Officers in matters relating to their military status, such communications are sent through the regular officer who is stationed nearest the Reserve Officer's place of residence. This administrative control extends to correspondence courses, but does not include promotions, assignments, or training of officers in the Branch Assignment Group.

THE matter of a suitable assignment is perhaps more important to a Reserve Officer than any other problem relating to his service, with the possible exception of the means whereby he may properly prepare himself to be of the most service in that assignment. An officer who is desired for special service must, of necessity, be assigned on the basis of the information available in the office of the Chief of Ordnance. This information is frequently very incomplete, and unsatisfactory assignments have occasionally resulted.

A study has been made with a view to providing more comprehensive information, without at the same time requiring extra labor on the part of Reserve Officers in the preparation of reports. The basis of the new system of records will be two cards, a qualififfication card and a record card. The first will be filled in by each Reserve Officer to show certain necessary data as to past experience. It will be of permanent value and will not be in the nature of a periodical report. The record card will be kept up to date in the office of the Chief of Ordnance, and will contain all pertinent information regarding matters which are subject to change, such as address, assignment, duties while on active duty, civil occupation, promotions, and activities such as correspondence courses, lectures or articles of a technical nature, and any other matter which is a part of his military history or should be considered in determining his assignment or recommending his examination for promotion.

At the time the qualification cards are sent out each officer will be given the opportunity to request reassignment if he considers that his present assignment is not in the best interests of the Service. In order that each

officer may have available complete information on which to base his consideration of this matter, information regarding the present organization of the Ordnance Department and the duty of the various subdivisions is published on page 692 of this issue.

FUNDS are available for training about eighty officers of the Branch Assignment Group prior to July 1st, 1925. It is contemplated that training for fifteen day periods will be conducted in small groups during April, May or June at the Manufacturing Arsenals and in the Ordnance Office. Officers who wish training this year are requested to send applications to the office or activity to which assignd, giving the time that will be most suitable. Officers to be trained will be selected by the office to which assigned, preference being given to those who have not had prior training. Officers who are selected will be notified as promptly as possible in order that their personal affairs may be arranged. In order to avoid disarrangement of personal affairs it is suggested that no definite plans be made until the actual receipt of orders.

COLONEL CHARLES W. MILLER, Ord. O. R. C., has just completed fifteen days active duty in the Office of the Assistant Secretary of War.

ON Tuesday, November 25th, the second of the series of lectures being given for all Ordnance Reserve Officers, members of the New York Post and of the National Defense Section of the American Society of Mechanical Engineers, as well as the manufacturers assigned to Ordnance in that District, was given at the Engineers Building, 29 West 39th Street, New York City. General Samuel McRoberts, Ordnance, O. R. C., a member of the New York Ordnance Advisory Board, presided. The first lecture was given by Major P. J. O'Shaughnessy on the subject of "Contracts," covering the proposed wartime contracts that are being developed; the second lecture, by Major J. K. Crain, on "Raw Materials," strategic raw materials being especially dwelt upon.

MAJ. JOHN B. ROSE, U. S. A., Chief of the Artillery Division of the Ordnance Department, Washington, D. C., gave an instructive lecture to Ordnance Reserve Officers on December 15 in the Engineering Societies Building, New York City.

His subject was "Artillery," and numerous photographs and drawings of the latest type of artillery were shown by stereoptican. There was a large attendance.

WHAT is considered the most important of the series of lectures for Ordnance Reserve officers and manufacturers of the New York Ordnance District was that of January 12, at which Mr. Charles M. Schwab presided.

The subject of this lecture, which was illustrated, covered "Small Arms," and was given by Maj. G. P. Wilhelm, U. S. A., Chief of the Small Arms Division, Office of the Chief of Ordnance, Washington.

Col. James L. Walsh, Ord. O. R. C., Chief of the New York District, arranged the series of lectures for the winter season of 1924-1925, each lecture being presided over by a member of the United States Ordnance Advisory Board, composed of leaders of industry.

The success of these lectures has been gratifying, and the speakers have done much to familiarize the officers and manufacturers of the New York District with Ordnance material that must be produced in the event of war.

Brig. Gen. Thompson a Reserve Officer

COL. JOHN TALIAFERRO THOMPSON, U. S. A., retired, formerly of the Ordnance Department, has been appointed a brigadier general in the Reserve Corps. It was due largely to Col. Thompson's work, extending over a period of many years, that the present high state of efficiency of the service shoulder-rifle was attained, and since his retirement from the active list some years ago has been devoting much of his time to development of a satisfactory semiautomatic shoulder-rifle.

At beginning of the World War he was recalled from the retired list to active duty in the office of the Chief of Ordnance and made chief of the Small-arms Division. For his work at the head of this division he was awarded the distinguished service medal. Later he was advanced to the rank of brigadier general and made director of arsenals. He holds the degree of L L. D. from Indiana University.

Lieut. Col. Frank Granger Bolles

LT. COL. FRANK GRANGER BOLLES, a prominent member of the Ordnance Officers' Reserve Corps and a member of the Army Ordnance Association, died October 31, 1924.

Born, Watertown, Wis., June 4, 1865, Col. Bolles received his early training and education in Watertown and Milwaukee, Wis. As a young man he was first connected with the Government Service in the Pension Office. After several years he entered his business career which was largely along editorial and advertising lines, for such concerns as the Westinghouse Electric Company, Pittsburgh; Bullock Electric Company, Cincinnati; The Allis-Chalmers Company, Milwaukee; and The Evinrude Motor Company, Milwaukee.

He was sent abroad by the Government as an engineer to make a study of industrial conditions, this study covering a period of several years. He then became associated with the International Trade Press, where he served until the United States entered the World War. He was appointed Major of Ordnance and was first assigned to the Bethlehem Steel Corporation. Later he was transferred to the Mosler Safe Company of Hamilton, Ohio. After a short period he was called for duty in France and was in active service abroad for a period of approximately nine months. On his return he was assigned to the War Claims Board and promoted to Lieutenant Colonel. He received an honorable discharge from service in November, 1919, and then resumed his connection with the International Trade Press of Chicago as director of research.

Colonel Bolles was a member and officer in a number of associations connected with the Army, including, in addition to the Army Ordnance Association, the Military Order of the World War, American Legion, Reserve Officers Association of the United States. He was also a member of several advertising clubs, the Adventurers Club and several engineering societies including the American Society of Mechanical Engineers.

Recently Commissioned Ordnance Reserve Officers

THE following have accepted reserve commissions since the last issue of ARMY ORDNANCE:

Brig. Gen. John T. Thompson, Ord. ORC., Banks St., New Canaan, Conn.
Col. Herman A. Metz, Ord. ORC., 38 West 74th St., New York, N. Y.
Lieut. Col. Oscar H. Fogg, Ord. ORC., 130 East 15th St., New York, N. Y.
Lieut. Col. Robert F. Gadd, Ord. ORC., 76 Kenyon St., Hartford, Conn.
Major John A. Bell, Ord. ORC., 816 Washington Ave., Carnegie, Pa.
Major Albert K. Chapman, Ord. ORC., 296 Seneca Parkway, Rochester, N. Y.
Major Louis A. Dearr, Ord. ORC., 216 N. 16th St., Quincy, Ill.
Major James B. Fitzgerald, Ord. ORC., Hollywood, Ill.
Major Walter W. Golden, Ord. ORC., 129 18th St., Warwood, Wheeling, W. Va.
Major William H. Keen, Ord. ORC., Care of Indlum Steel Co., Watervliet, N. Y.
Major Floyd K. Richtmyer, Ord. ORC., 307 Fairmont Ave., Ithaca, N. Y.
Major William P. Turner, Ord. ORC., Purdue Univ., West Lafayette, Ind.
Major George A. Voss, Ord. ORC., 264 74th St., Brooklyn, N. Y.
Major Charles Yon, Ord. ORC., 1080 Chestnut St., Coraopolis, Pa.
Capt. Donald H. Atherton, Ord. ORC., 200 Glenwood Glade, Oakland, Calif.
Capt. Jay S. Buckley, Ord. ORC., 77 Cottage Ave., Ansonia, Conn.
Capt. Charles B. Carter, Ord. ORC., 501 Surf St., Chicago, Ill.
Capt. Rudolph H. Fox, Ord. ORC., Pig Point, Portsmouth, Va.
Capt. Frank J. Googins, Ord. ORC., 1407 Commonwealth Ave., Boston, Mass.
Capt. Walter Graham, Ord. ORC., 1328 North Tejon St., Colorado Springs, Colo.
Capt. Ralph H. Higgins, Ord. ORC., Uxbridge, Mass.
Capt. Alfred C. Lingloff, Ord. ORC., Fort Hayes, Columbus, Ohio.
Capt. Melville L. Merrill, Ord. ORC., 26 Keeney Ave., West Hartford, Conn.
Capt. Edward R. Neville, Ord. ORC., 22 Third St., Lowell, Mass.
Capt. Charles G. Spice, Ord. ORC., 97 Farmington Ave., Hartford, Conn.
Capt. Allen C. Staley, Ord. ORC., Purdue Univ., Lafayette, Ind.
Capt. Arthur G. Tibby, Ord. ORC., 86 F St., Salt Lake City, Utah.
Capt. Wallace C. Welch, Ord. ORC., Hdqrs. 4th Corps Area, Atlanta, Ga.
Capt. William Zwicky, Ord. ORC., Rapid City, South Dakota.
1st Lieut. Thomas W. Bell, Ord. ORC., Pig Point, Portsmouth, Va.
1st Lieut. Willard F. Cox, Ord. ORC., Wilber, Nebr.
1st Lieut. William F. Dougherty, Ord. ORC., Bushton, Kans.
1st Lieut. Perle T. Eichelberger, Ord. ORC., 26 Wisteria Drive, Dayton, Ohio.
1st Lieut. David S. Henderson, Ord. ORC., 33 Hobson St., Newark, N. J.
1st Lieut. Harry A. Hirsch, Ord. ORC., 1445 North Lawrence St., Philadelphia, Pa.
1st Lieut. Harry Lauterbach, Ord. ORC., 1317 Drake Ave., Burlingame, Calif.
1st Lieut. Lewis B. Lindemuth, Ord. ORC., 40 Wall St., New York, N. Y.
1st. Lieut. Arthur D. Morriss, Ord. ORC., Washington Ave., Hillsdale, Bergen Co., N. J.
1st Lieut. Oliver M. Olson, Ord. ORC., Press Club, San Francisco, Calif.
1st Lieut. Virgil C. Pritchett, Ord. ORC., 12 Highland Ave., Maplewood, N. J.
1st Lieut. Justus Rising, Ord. ORC., 503 Waldron St., West Lafayette, Ind.
1st Lieut. Stanley C. Schultz, Ord. ORC., 28 Twin Oaks Apt., Akron, Ohio.
1st Lieut. Luther M. Walton, Ord. ORC., Wernersville, Pa.
1st Lieut. Albert M. Young, Ord. ORC., 17 Gramercy Park, New York, N. Y.
2nd Lieut. Lawrence A. Anderson, Ord. ORC., 130 Precita Ave., San Francisco, Cal.
2nd Lieut. William P. Blackwell, Jr., Ord. ORC., 72 West Adams St., Room 950, Chicago, Ill.
2nd Lieut. Thomas H. Bradley, Ord. ORC., 4253 Halldale Ave., Los Angeles, Calif.
2nd Lieut. Hiram K. Briggs, Ord. ORC., 1601 West 27th St., Minneapolis, Minn.
2nd Lieut. Christopher M. Conway, Ord. ORC., 17 Clifton Place, Brooklyn, N. Y.
2nd Lieut. Henry F. Culver, Ord. ORC., 930 Edgecomb Place, Chicago, Ill.
2nd Lieut. Wilson H. Eastman, Ord. ORC., 239 Oak St., Atlanta, Ga.
2nd Lieut. Cornelius E. Heath, Ord. ORC., The Thomson Club, 24 Baker St., Lynn, Mass.
2nd Lieut. Fred C. McCafferty, Ord. ORC., 421 Center St., Wilkinsburg, Pa.
2nd Lieut. Louis Rudnick, Ord. ORC., 109 Cole Ave., Williamstown, Mass.
2nd Lieut. Arthur Steil, Ord. ORC., Box 547, Fernandina, Fla.
2nd Lieut. Benjamin E. Watkins, Ord. ORC., Indian Springs, Ga.
2nd Lieut. Clyde Whitlatch, Ord. ORC., Hdqrs. 2nd Corps Area, Governors Island, N. Y.
2nd Lieut. Theodore E. Xistris, Ord. ORC., Y. M. C. A. Bldg., Appleton, Wis.

Recently Assigned Ordnance Reserve Officers

THE following reserve officers have recently been assigned as indicated after their names:

Col. Herman A. Metz, Ord. ORC., 38 West 74th St., New York, N. Y., Territorial Assignment Group.

Lieut. Oscar H. Fogg, Ord. ORC., 130 East 15th St., New York, N. Y., Field Service, Maintenance Division, Washington, D. C.

Lieut. Col. Robert F. Gadd, Ord. ORC., 76 Kenyon St., Hartford, Conn., Territorial Assignment Group.

Lieut. Col. Elmer E. Ware, Ord. ORC., 319 Westminster Ave., Detroit, Mich., Manufacturing Service, Nitrate Plant, Muscle Shoals, Ala.

Major John A. Bell, Ord. ORC., 816 Washington Ave., Carnegie, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

Major Albert W. Draves, Ord. ORC., 1284 Stowell Ave., Shorewood, Milwaukee, Wis., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

Major Walter W. Golden, Ord. ORC., 129 18th St., Warwood, Wheeling, W. Va., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

Major George W. Morrison, Ord. ORC., P. O. Box 146, Latrobe, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

Major Floyd K. Richtmyer, Ord. ORC., 307 Fairmont Ave., Ithaca, N. Y., Manufacturing Service, Buffalo District Ordnance Office, Watervliet Arsenal, Watervliet, N. Y.

Major George A. Voss, Ord. ORC., 264 74th St., Brooklyn, N. Y., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

Major Charles Yon, Ord. ORC., 1080 Chestnut St., Coraopolis, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

Capt. Donald H. Atherton, Ord. ORC., 200 Glenwood Glade, Oakland, Calif., Territorial Assignment Group.

Capt. Charles B. Carter, Ord. ORC., 501 Surf St., Chicago, Ill., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

Capt. L. A. Codd, Ord. ORC., 1906 N St., N. W., Washington, D. C., Manufacturing Service, Ammunition Division, Washington, D. C.

Capt. Edwin G. Davis, Ord. ORC., 7 Glenbrook Ave., Yonkers, N. Y., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

Capt. Frank J. Googins, Ord. ORC., 1407 Commonwealth Ave., Boston, Mass., Territorial Assignment Group.

Capt. Ralph H. Higgins, Ord. ORC., Uxbridge, Mass., Territorial Assignment Group.

Capt. Alfred C. Lindloff, Ord. ORC., Fort Hayes, Columbus, Ohio, Territorial Assignment Group.

Capt. Ernest L. Lucas, Ord. ORC., A. & M. College, Miss., Manufacturing Service, Birmingham District Ordnance Office, Birmingham, Ala.

Capt. Melville L. Merrill, Ord. ORC., 26 Keeney Ave., West Hartford, Conn., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.

1st Lieut. Harry H. Needham, Ord. ORC., Erie Ordnance Depot, LaCarne, Ohio, Field Service, Erie Ordnance Reserve Depot, LaCarne, Ohio.

Capt. Arthur G. Tibby, Ord. ORC., 86 F St., Salt Lake City, Utah, Territorial Assignment Group.

Capt. William Zwicky, Ord. ORC., Rapid City, South Dakota, Territorial Assignment Group.

1st Lieut. Willard F. Cox, Ord. ORC., Wilber, Nebr., Territorial Assignment Group.

1st Lieut. William F. Dougherty, Ord. ORC., Bushton, Kan., Territorial Assignment Group.

1st Lieut. Perle T. Eichelberger, Ord. ORC., 26 Wisteria Drive, Dayton, Ohio, Manufacturing Service, Cincinnati District Ordnance Office, Cincinnati, Ohio.

1st Lieut. David S. Henderson, Ord. ORC., 33 Hobson St., Newark, N. J., Territorial Assignment Group.

1st Lieut. Harry Lauterbach, Ord. ORC., 1317 Drake Ave., Burlingame, Cal., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.

1st Lieut. Lewis B. Lindemuth, Ord. ORC., 40 Wall St., New York, N. Y., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

1st Lieut. Arthur D. Morriss, Ord. O. R. C., Washington Ave., Hillsdale, Bergen County, N. J., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

1st Lieut. Oliver M. Olson, Ord. ORC., Press Club, San Francisco, Calif., Manufacturing Service, Aircraft Armament Division, Washington, D. C.

1st Lieut. Clifford B. Potter, Ord. ORC., 1206 2nd National Bank Bldg., Toledo, Ohio, Manufacturing Service, Chicago District Ordnance Office.

1st Lieut. Justus Rising, Ord. ORC., 503 Waldron St., West LaFayette, Ind., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.

1st Lieut. Stanley C. Schultz, Ord. ORC., 28 Twin Oaks Apt., Akron, Ohio, Manufacturing Service, Cleveland District Ordnance Office, Cleveland, Ohio.

1st Lieut. Gordon C. Tibbitts, Ord. ORC., 22 Carroll Ave., Takoma Park, D. C., Manufacturing Service Ammunition Division, Washington, D. C.

1st Lieut. Luther M. Walton, Ord. ORC., Wernersville, Pa., Manufacturing Service, Frankford Arsenal, Philadelphia, Pa.

1st Lieut. Albert M. Young, Ord. ORC., 17 Gramercy Park, New York, N. Y., Manufacturing Service, New York District Ordnance Office, New York, N. Y.

2nd Lieut. Lawrence A. Anderson, Ord. ORC., 130 Precita Ave., San Francisco, Calif., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.

2nd Lieut. William P. Blackwell, Jr., Ord. ORC., 72 West Adams St., Chicago, Ill., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

2nd Lieut. Thomas H. Bradley, Ord. ORC., 4253 Halldale Ave., Los Angeles, Calif., Territorial Assignment Group.

2nd Lieut. Hiram K. Briggs, Ord. ORC., 1601 W. 27th St., Minneapolis, Minn., Territorial Assignment Group.

2nd Lieut. Dennis W. Brosnan, Jr., Ord. ORC., 242 Pine St., Albany, Ga., Manufacturing Service, Birmingham District Ordnance Office.

2nd Lieut. Christopher M. Conway, Ord. ORC., 17 Clifton Place, Brooklyn, N. Y., Territorial Assignment Group.

2nd Lieut. Edward L. Cox, Ord. ORC., Y. M. C. A., Appleton, Wis., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

2nd Lieut. Allan M. Crain, Ord. ORC., 5811 Glenview Ave., Cincinnati, Ohio, Technical Staff, Aberdeen Proving Ground, Md.

2nd Lieut. Henry F. Culver, Ord. ORC., 930 Edgecomb Place, Chicago, Ill., Territorial Assignment Group.

2nd Lieut. Wilson H. Eastman, Ord. ORC., 239 Oak St., Atlanta, Ga., Manufacturing Service, Birmingham District Ordnance Office, Birmingham, Ala.

2nd Lieut. Cornelius E. Heath, Ord. ORC., The Thomson Club, 24 Baker St., Lynn, Mass., Territorial Assignment Group.

2nd Lieut. Clarence Jensen, Ord. ORC., 221 11th St., Racine, Wis., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

2nd Lieut. Herbert S. Karch, Ord. ORC., U. S. Bureau of Mines, 4800 Farbes St., Pittsburgh, Pa., Manufacturing Service, Pittsburgh District Ordnance Office, Pittsburgh, Pa.

2nd Lieut. Fred C. McCafferty, Ord. ORC., 421 Center St., Wilkinsburg, Pa., Territorial Assignment Group.

2nd Lieut. Louis Rudnick, Ord. ORC., 109 Cole Ave., Williamstown, Mass., Territorial Assignment Group.

2nd Lieut. William V. Sestok, Ord. ORC., 2424 Elmhurst Ave., Detroit, Mich., Technical Staff, Aberdeen Proving Ground, Md.

2nd Lieut. John Slezak, Ord. ORC., 156 North Oak Park Ave., Oak Park, Ill., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

2nd Lieut. Arthur Steil, Ord. ORC., Box 547, Fernandina, Fla., Manufacturing Service, Birmingham District Ordnance Office, Birmingham, Ala.

2nd Lieut. Theodore E. Xistris, Ord. ORC., Y. M. C. A. Bldg., Appleton, Wis., Manufacturing Service, Chicago District Ordnance Office, Chicago, Ill.

Recently Appointed Ordnance Reserve Officers

THE following reserve officers have accepted reappointment in the Ordnance Officers' Reserve Corps:

Lieut. Col. Charles O. Brown, Ord., ORC.
Hillcrest Lane, Rye, N. Y.

Lieut. Col. Edmund D. Campbell, Ord. ORC.,
915 Olive St., St. Louis, Mo.

Lieut. Col. Myron S. Falk, Ord. ORC.,
130 East 44th St., New York, N. Y.

Lieut. Col. William M. MacCleary, Ord. ORC.,
221 Corlies Ave., Pelham, N. Y.

Lieut. Col. James Stewart, Ord. ORC.
Ardsheal Ranch, P. O. Box 116, La Habra, Calif.

Major Paschal W. Barr, Ord. ORC.,
343 W. Lancaster Pike, Ardmore, Pa.

Major Robert W. Burgess, Ord. ORC.,
195 Broadway, New York, N. Y.

Major Howard P. Elwell, Ord. ORC.,
Fernwood, Gloucester, Mass.

Major Ernest C. Goddard, Ord. ORC.,
1911 N. 33rd St., Philadelphia, Pa.

Major Raymond D. McGrath, Ord. ORC.,
Care Lazard Freres, 120 Broadway, New York, N. Y.

Major Thomas Moore, Ord. ORC.,
1128 Fillmore St., Frankford, Philadelphia, Pa.

Major John B. Read, Ord. ORC.,
1520 Maple St., Golden, Colo.

Major Henry J. Savage, Ord. ORC.,
Care McLaren Products Co., Dayton, Ohio.

Capt. Harry L. Beshore, Ord. ORC.,
511 Spencer Ave., Marion, Ind.

Capt. William C. Bliss, Ord. ORC.,
4929 Lutus Ave., St. Louis, Mo.

Capt. Lyman D. Bothwell, Ord. ORC.,
2215 East 97th St., Cleveland, Ohio.

Capt. Harold W. Bristol, Ord. ORC.,
12 W. Main St., Washington, N. C.

Capt. Frederick C. Cooke, Ord. ORC.,
Freeborn St., Portsmouth, R. I.

Capt. Augustine J. Daly, Ord. ORC.,
12 Spruce St., Westerly, R. I.

Capt. Fred L. Dean, Ord. ORC.,
Hdqrs. 3rd Div., Camp Lewis, Wash.

Capt. Verne G. DeCamp, Ord. ORC.,
713 E. Washington St., Huntington, Ind.

Capt. Earl G. Grenier, Ord. ORC.,
21 Shepherd Place, Utica, N. Y.

Capt. Reginald W. Hay, Ord. ORC.,
120 St. Paul's Road, Ardmore, Pa.

Capt. Langhorne D. Lewis, Ord. ORC.,
Frankford Arsenal, Bridesburg Sta., Philadelphia, Pa.

Capt. Warner McLaughlin, Ord. ORC.,
P. O. Box 433, Port Henry, N. Y.

Capt. Frederick T. Mason, Ord. ORC.,
50 Hamilton St., Wollaston, Mass.

Capt. Edwin J. Mullen, Ord. ORC.,
44 Jackson St., New Rochelle, N. Y.

Capt. Charles A. Tibbals, Jr., Ord. ORC.,
511 Hawthorn Lane, Winnetka, Ill.

1st Lieut. Harry A. Blankenship, Ord. ORC.,
1325 Market St., Parkersburg, W. Va.

1st Lieut. John O. Brennan, Ord. ORC.,
25 Fairview Ave., Dover, N. J.

1st Lieut. Albert G. Brussart, Ord, ORC.,
420 Pine St., Steelton, Pa.

1st Lieut. Virgil N. Charles, Ord. ORC.,
Y. M. C. A., St. Joseph, Mo.

1st Lieut. Robert H. Featherstone, Ord. ORC.,
Wardman Park Annex, Washington, D. C.

1st Lieut. Guy M. Daniels, Ord. ORC.,
Route No. 1, Rensselaer, Ind.

1st Lieut. Benjamin H. Hosler, Ord. ORC.,
2400 Oliver Bldg., Pittsburgh, Pa.

1st Lieut. James W. Johnston, Ord. ORC.,
1825 Columbia Road, N. W., Washington, D. C.

1st Lieut. William R. Lucas, Ord. ORC.,
472 G St., S. W., Washington, D. C.

1st Lieut. Russell F. Macdonald, Ord. ORC.,
822 Walker Ave., Oakland, Calif.

1st Lieut. Robert M. Schiller, Ord. ORC.,
17 North Wabash Ave., Chicago, Ill.

2nd Lieut. Maurice A. Barancik, Ord. ORC.,
38 S. Dearborn St., Chicago, Ill.

2nd Lieut. Jesse A. Bell, Ord. ORC.,
821 Thorne St., Fresno, Calif.

2nd Lieut. William H. Cansfield, Ord. ORC.,
222 W. Washington St., Howell, Mich.

2nd Lieut. William C. Cook, Ord. ORC.,
Geer Bldg., Turlock, Calif.

2nd Lieut. William C. Graustein, Ord. ORC.,
19 Arlington St., Cambridge, Mass.

2nd Lieut. Henry E. Gulbrandsen, Ord. ORC.,
238 S. 39th St., Philadelphia, Pa.

2nd Lieut. Otto P. Mann, Ord. ORC.,
461 Church St., Beverly, N. J.

2nd Lieut. Samuel F. Poindexter, Ord. ORC.,
518 Onley Road, Norfolk, Va.

2nd Lieut. John C. Tashner, Ord. ORC.,
90 Brown Pl., Jersey City, N. J.

Mobilization Plans

RESERVE officers are being commissioned and trained for service in the event of a general mobilization. Plans for this mobilization are being prepared in great detail, so that the resources of the country may be utilized to the best advantage, and so that there may be a minimum of delay, confusion and wasted effort. In order that each reserve officer may be informed as to the nature of the plans necessary, and as to the steps which are being taken by the Ordnance Department to properly fulfill its functions in the event of a general mobilization, the following Office Order is published:

OFFICE ORDER No. 569:

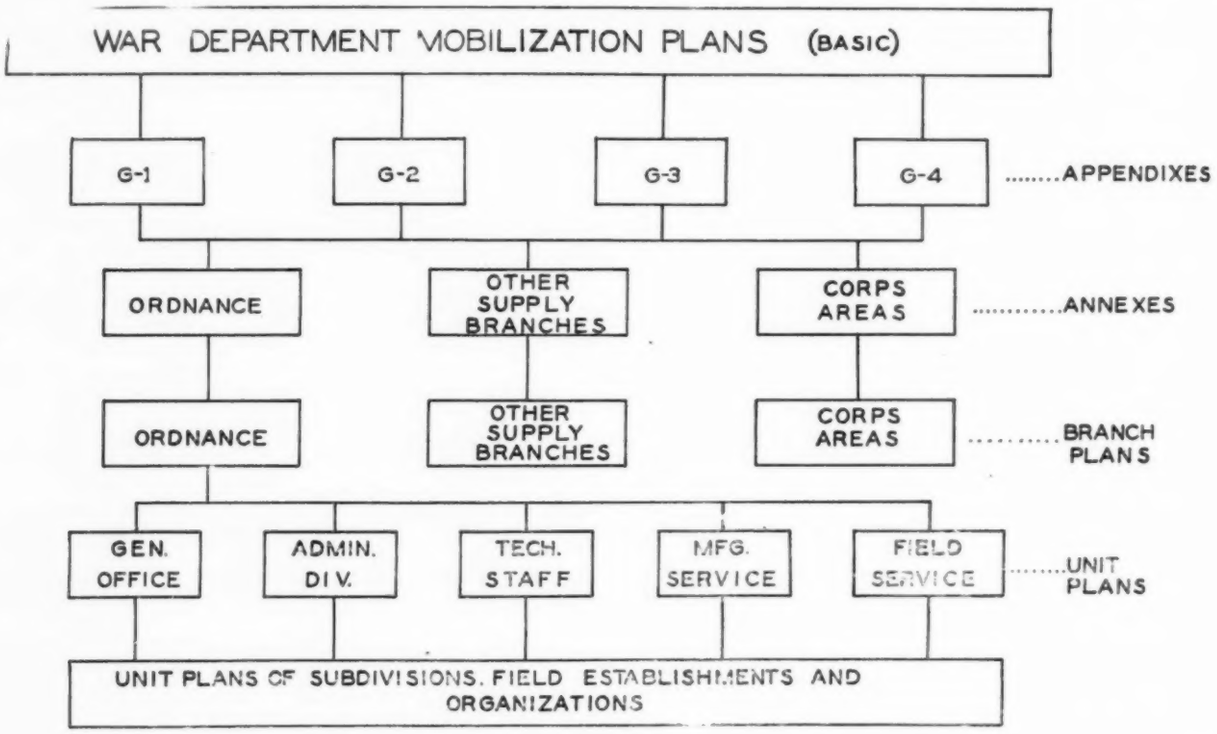
November 6, 1924.

1. **Mobilization Plans:** The War Department General Mobilization Plan contains the general instructions and principles which determine the fundamental steps necessary to the mobilization of the man-power and industrial resources sufficient for a major emergency.

7. Each Branch Plan will be an abstract or compilation of the Unit Mobilization Plans of the following sub-divisions of the Ordnance Office: General Office; Administration Division; Technical Staff; Manufacturing Service; Field Service.

Unit Plans

8. Unit Mobilization Plans, supporting each Ordnance



2. With the General Mobilization Plan as a basis, situations demanding a greater or lesser effort are covered by War Department Supplementary Mobilization Plans.

Ordnance Annexes

3. Ordnance Annexes to each War Department Mobilization Plan will be prepared by the War Plans Section. Necessary data for these Annexes will be prepared by the appropriate sub-divisions of the Ordnance Office.

4. The form and contents of Ordnance Annexes are prescribed in Army Regulations No. 120-10.

Ordnance (Branch) Mobilization Plans

5. Ordnance (Branch) Mobilization Plans, corresponding to each War Department Mobilization Plan, will be prepared, as hereinafter outlined, under the supervision of the War Plans Section.

6. The purpose of the Branch Plans is to establish the responsibilities and outline the actions necessary to the fulfillment of the missions given by the Ordnance Annexes.

(Branch) Mobilization Plan, will be prepared by the five major sub-divisions of the Ordnance Office listed above, by such sub-divisions of their office as they may designate, and by all field establishments and Ordnance companies under the exclusive control of the Chief of Ordnance.

9. Unit Plans, so far as may be practicable, will be prepared in the following form:

Part I: Administration and Finance.
Part II: Military Personnel and Training;
Part III: Technical;
Part IV: Procurement;
Part V: Supply.
Parts I and II will be applicable to all Unit Plans.

10. Each Unit Plan will make provision for covering the following subjects, *so far as they may be applicable* to the establishment or unit concerned:

Part I: Administration and Finance

a. Organization of office or establishment (chart).

b. Office space requirements.
c. Office equipment and supplies requirements.
d. Civilian personnel requirements:
   (1) Classification, by designation and rates of pay (table).
   (2) Assignment of key men (table).
   (3) Methods of recruitment.
   (4) Training Plans.
   (5) Hospitalization, housing and welfare.
   (6) Civil Service relations.
   (7) Estimate of total funds required for salaries.
e. Legal advisory matters.
f. Means of communication requirements (tables):
   (1) Telephone.
   (2) Telegraph.
   (3) Radio.
   (4) Courier.
g. Transportation requirements (tables):
   (1) Animal drawn.
   (2) Motor.
   (3) Rail.
   (4) Water.
h. Power requirements (exclusive of manufacture) (tables).
i. Information plans:
   (1) Instructions and policies.
   (2) Technical:
      Training Regulations.
      Inspection Manuals.
      Range and firing tables.
      Ballistic tables.
   (3) Progress Reports:
      Production.
      Issue.
   (4) Miscellaneous records.
   (5) Statistics.
i. New construction (exclusive of hospitalization, housing, welfare, and production activities) and extensions to light, heat, water, and sewer systems.
k. Fiscal requirements (tables):
   (1) Administrative (including training).
   (2) Issue.
   (3) Maintenance.
   (4) Development and research.
   (5) Manufacturing.
l. Industrial relations:
   (1) Wage schedules.
   (2) Payrolls.
   (3) Sanitation.
m. Military Intelligence—counter espionage.
n. Guard and Fire Protection.

Part II: Military Personnel and Training

a. Table of Organization.
b. Assignment table.
c. Requirements by months; rate of call to active duty.
d. Procurement of commissioned personnel.
e. Recruiting of enlisted personnel.
f. Plans for training.
g. Hospitalization, housing and welfare.
h. Organization and individual equipment and supplies. (Military units and detachments.)

Part III: Technical

a. Standards for manufacture.
b. Substitutes for manufacture, including relative facility of production.
c. Rearming program.
d. Training of technical civilians for proving grounds.

Part IV: Procurement

a. Production requirements.
b. Scheduled production.
c. Allocation of War orders.
d. Status of War orders allocated.
e. Drawings, specifications and bills of material.
f. Special procurement plans not allocated to districts or arsenals.
g. Plans for procurement of critical material.
h. Gage plan.
i. Jigs, fixtures, special tools and dies.
j. Raw material requirements.
k. Special material requirements.
l. Machine tool requirements.
m. Manufacturing power requirements.
n. Manufacturing facility requirements.
o. Special projects (proving grounds, loading plants, etc).
p. Manufacturing information.
q. Plant protection.
r. Delegation of local procurement authority to Corps Areas.

Part V: Supply

a. Mobilization requirements (Corps Areas, Exempted Stations).
b. Mobilization stocks:
   (1) In hands of troops.
   (2) In storage.
c. Shortages.
d. Priorities of issue and shipment.
e. Substitutes for shortages.
f. Overhaul and conditioning of unserviceable stocks.
g. Distribution of stocks (allocations to fill shortages).
h. Designation of depots responsible for supply of supply points.
i. Plan of issue.
j. Coordination with production districts.

11. Part I of each Unit Plan will include the following:
a. An organization chart, conforming to the basic chart of the Ordnance Department, to be approved by the next higher authority.
b. Table showing office space requirements by months after M Day.
c. Tables showing requirements for office supplies and equipment, tabulated to show major items of equipment such as desks, tables, typewriters, chairs, filing cases, safes, calculating machines and duplicating machines by numbers, and the miscellaneous drafting and office supplies by money value (by months after M Day).
d. Under civilian personnel will be included:
   (1) Tables showing by number, grades and rates of pay when they will be required (by months after M Day).
   (2) Table showing assignment of civilans in key positions by name. This should show when each will be required. (By months after M Day.)

(3) Plans for procurement of civilian personnel will include necessary liaison with schools, technical societies, etc., for recruiting technical civilians for key positions.

(4) Training plans will embrace the training of all civilian personnel assigned to the establishment or unit and such as may be designated for training by the establishment or unit.

(5) Plans for hospitalization, shelter and welfare will include necessary bed capacity and the number and types of buildings.

(6) Under Civil Service relations will be included recommendations for necessary changes in Civil Service regulations to permit efficient functioning of the Mobilization Plans.

(7) The estimate of funds required for salaries of civilian employees will be tabulated to show requirements by months after M Day.

e. Under legal advisory matters will be included definite recommendations for changes in legislation restricting the operations of the Ordnance Department in time of war, such as the Eight-Hour Law; legislation requiring proposals for procurement of services or supplies, and provisions in appropriations Acts limiting procurement, printing, advertising, etc.

f. Tables showing requirements for telephones, leased wires, radio service, etc., will show need by months after M Day.

g. Transportation requirements will be given for:

(1) That required locally for the operation of the establishment or unit.

(2) That required for outgoing and incoming shipments.

h. Power requirements will be expressed in terms of kilowatts; special requirements for steam, gas or oil equipment may be expressed in horsepower.

i. Each Unit Plan will provide for the preparation of such training regulations, manuals, etc., as may be charged to the establishment or unit concerned.

j. Requirements in new construction (exclusive of hospitalization, housing, welfare and production activities) will include numbers, types and sizes of buildings required and estimated cost of such construction.

k. Each Unit Mobilization Plan will contain an estimate of the funds required under each Ordnance Department appropriation and under any appropriation of other Departments in which the Ordnance Department is concerned, such as Transportation of the Army, etc. This estimate will show:

(1) Amounts required on M Day.

(2) Amounts required during the first phase (four months).

(3) Amounts required during the first year.

(4) Contract authorizations necessary for first eighteen months.

l. Under "Industrial Relations" will be included such matters as rates of pay, leaves, hours of labor, transportation, sanitation and general conditions affecting the efficiency of employees.

m. Under "Military Intelligence" will be included the plans for necessary liaison of field establishments with Corps Area Commanders, liaison with the Department of Justice agencies, and provisions for plant protection and prevention of sabotage.

12. Each Unit Plan will contain, under Part II, the following:

a. Table of organization, to be approved by the next higher authority.

b. Assignment table for military personnel. It will include organizations by unit designation, regular officers by number and rank, and reserve officers by name.

c. A table paralleling the table of organization, showing by number, grades, and assignment, when commissioned personnel should report for active duty (by months after M Day.)

d. A table, paralleling the assignment table, showing when each officer should report for duty (by months after M Day).

e. Maximum enlisted strength, by numbers and grades, authorized for procurement by recruiting or from draft (by months after M Day).

f. Plans for procurement of officers to meet the objective set by the table of organization.

g. Plans for the recruiting of authorized enlisted personnel prior to the operation of the draft, in accordance with mobilization priorities.

h. Plans for training will embrace the training of personnel assigned to the establishment or unit and other personnel with the training of which the establishment or unit is charged, and will include the following:

(1) Equipment and supplies necessary;
(2) Complete courses of instruction;
(3) Conduct of courses.

i. Plans for hospitalization and shelter should show the necessary bed capacity and location, number and types of buildings, including mess halls, lavatories, barracks, officers' quarters, etc.

13. Each Unit Plan will contain a list of the actions necessary to put the plan into effect.

14. Unit Mobilization Plans must be flexible in character and capable of prompt execution with necessary modifications to meet minor changes in the War Department Mobilization Plans.

15. The original and one copy of the Unit plans of the five major sub-divisions of the Ordnance Office will be filled with the War Plans Section.

16. Unit Plans of Ordnance Companies on duty at exempted stations will be prepared in the following form:

Part I: Personnel.
Part II: Intelligence.
Part III: Organization and Training.
Part IV: Supply.

General Instructions

17. The Requirements and War Plans Section is charged with supervision of the preparation of all mobiliza-

tion plans and with the custody of all war plans referred to the Ordnance Department for action or study.

18. Ordnance Annexes and Mobilization Plans will be prepared on paper of legal cap size, typing single spaced, with at least a one-inch margin at the top and bottom, and at least one and a half inch margin at the left of the page. If larger sized sheets are used they will be folded to legal size. Maps, tables, charts, drawings, etc., will be prepared for binding in a book of legal cap size.

19. The following mobilization requirements of establishments and units will be forwarded for consolidation in the General Office and Administration Division when called for by the War Plans Section:

a. Military personnel.
b. Civilian personnel.
c. Fiscal.
d. Means of communication (telephone and telegraph).
e. Transportation (animal drawn, motor and rail).
f. New construction (exclusive of production activities).
g. Power (exclusive of manufacture).

20. The Manufacturing Service and Field Service will be responsible for the preparation of unit plans for new installations required by the Mobilization Plan.

21. Annexes and Mobilization Plans of the Ordnance Department based on the War Department General Mobilization Plan, 1924, will be prepared and revised in accordance with the following schedule:

a. Unit Mobilization Plans of the five main sub-divisions of the Ordnance Office____Jan. 31, 1925;
b. All other Unit plans_____Mar. 31, 1925.

22. It is desired to emphasize the point that our Mobilization Plans should be as brief as practicable. Charts and tables will be used whenever possible. Long and detailed descriptive matter should be avoided.

23. Based on this directive, the five major divisions of the Ordnance Office will issue such instructions, concerning mobilization plans, to units and establishments under their control as may be required.

24. The attached chart shows the relation of Unit Plans to the Ordnance (Branch) Mobilization Plans and to the War Department Mobilization Plans, their Appendices and Annexes.

Special Instructions

25. The Ordnance Department (Branch) Mobilization Plans will be prepared in the form prescribed for Unit Plans. Responsibility for the preparation of the Branch Plans will be as follows:

a. The General Office will be responsible for the preparation of that portion of the Branch Plans covering the subjects *a, g, h, i, k* and *m*, under Part I of the Unit Plans and for Part II. It will consolidate the total requirements of the Ordnance Department for transportation, funds, military personnel and power (exclusive of production).

b. The Administration Division will be responsible for the preparation of that part of the Branch Plans covering the subjects *b, c, d, e, f, j* and *l* given under Part I of Unit Plans, and for the consolidation of the total Ordnance Department requirements for means of communication, civilian personnel and new construction, etc., (exclusive of manufacture). Requirements in office space, supplies and equipment will be consolidated for the Ordnance office only.

c. The Technical Staff, Manufacturing Service and Field Service will be responsible for the preparation of Parts III, IV and V, respectively, of the Ordnance (Branch) Plans.

26. The General Office will be responsible for the preparation and maintenance of requirement sheets of ordnance items of issue required to meet the needs of any War Department Mobilization Plan.

27. The Administration Division will include in its Unit Plans definite recommendations for any necessary changes or modifications in property regulations.

28. The Technical Staff will be responsible for the maintenance of a Book of Standards of ordnance items of issue.

29. The Manufacturing Service will maintain production sheets for items of issue corresponding to the requirement sheets kept by the War Planning Section. It will also compute and maintain requirement and production sheets for the necessary raw materials, such as explosives, optical glass and the necessary components of issue items.

30. The Mobilization Plan of each Manufacturing Division will include a list showing the items of issue for which it is responsible, together with a statement of the status of each item with respect to:

a. Approved design.
b. Drawings, specification and bills of material.
c. Methods of manufacture.
d. Provision of gages.
e. Design of special dies, jigs, tools and fixtures.
f. Training Regulations and Inspection Manuals.
g. Allocation of War orders.

31. The Unit Plan of the Manufacturing Service will include a definite scheme for the utilization of finished and semi-finished components of items of issue now on hand.

32. The Field Service will be responsible for the computation of Zone of Interior requirements for ordnance supplies under each War Department Mobilization Plan. Theater of Operations requirements will be computed by the General Office.

33. The Field Service will submit to the War Plans Section on July 1st of each year a consolidated inventory of ordnance items of issue showing the status as of March 1st. This will show stocks on hand:

a. In the hands of troops;
b. In storage.

In addition, report will be made at the same time showing amounts of ammunition expended during the previous year for target practice and amounts lost through deterioration or other causes.

C. C. WILLIAMS,
Major General, Chief of Ordnance.

Organization of the Ordnance Department

THE organization of the Ordnance Department has been materially changed since the War, and the majority of officers of the Ordnance Officers' Reserve Corps have little knowledge of the present organization or of the functions of the various sub-divisions. Such knowledge is necessary in order to enable an officer to determine the position in the organization for which his special qualifications best adapt him, and also to enable him to acquire that perspective of Ordnance work which is essential if he is to properly co-ordinate his efforts with the general aims of the Department. The latest order covering the organization of the Ordnance Office is printed here. In a later issue of ARMY ORDNANCE *information will be published regarding the organization of other Ordnance establishments, such as District Offices, Arsenals and Depots. A general knowledge of the organization of the Ordnance Department, and more detailed knowledge of the subdivisions to which assigned, will in the future be required in examinations for promotion.*

December 1, 1924.

OFFICE ORDER No. 573.

SUBJECT: *Organization of Ordnance Office.*

1. Office Order, No. 425, dated August 28, 1922, and all Ordnance Office Orders affecting the organization of the Ordnance Office conflicting with the following provisions are hereby revoked.

Section I

Function

2. It is the function of the Ordnance Department to design, procure, produce, inspect, store, preserve, maintain and supply such material as shall be prescribed by the Secretary of War.

Main Groups

3. The office of the Chief of Ordnance shall be divided into the following groups:

General Office,
Administration Division,
Technical Staff,
Manufacturing Service,
Field Service.

Charts and detailed group orders showing the organization and methods by which they will operate shall be prepared by each group and shall have, when approved by the Chief of Ordnance, the same force and effect as this order. All groups shall maintain the records, rosters and all other data required by their functions, and shall submit to the Chief of Ordnance such special reports, digests, etc., as he may direct. Subject to the approval of the Chief of Ordnance, they shall furnish reports and information of their own operations to the other groups of the Ordnance Office, and, upon request, to other official agencies. Each group or division shall establish and control such liaison as pertains exclusively to its functions.

Executive Officer

4. The Executive Assistant shall perform such duties as may be assigned to him by the Chief of Ordnance. The General Office and the Administration Division shall function under the direction of the Executive Assistant.

Section II

General Office

5. The General Office shall consist of the Executive Section, Fiscal Section, Statistics and War Plans Section, and the Military Personnel Section.

6. The duties of the General Office shall be:

a. To perform the miscellaneous executive duties required in the Ordnance Office. (Executive Section.)

b. To prepare the unit mobilization plans of the General Office required by Office Order No. 569, dated November 6, 1924.

c. To supervise and coordinate the liaison (other than technical) established by the Ordnance Office with other agencies of the War Department and the Federal Government. (Executive Section.)

d. To supervise the preparation and publication of official literature and other news matters concerning the Ordnance Department. (Executive Section.)

Fiscal

e. To have general charge of all estimates and of their presentation to Congress. (Fiscal Section.)

f. To have general charge of the apportionment and subapportionment of funds in the Ordnance Office and to keep record thereof. (Fiscal Section.)

g. To supervise and coordinate the business methods of the Ordnance Office, arsenals and other establishments thereunder in relation to all fiscal affairs. (Fiscal Section.)

h. To prepare procurement authorities for payrolls of the Ordnance Office personnel and other miscellaneous activities, including travel expenses of officers and civilians, and maintain a record of the estimated cost of travel. (Fiscal Section.)

i. To maintain a Finance Contact Branch which shall act as liaison on all finance matters with the Chief of Finance, all Bureaus of the War Department, and other government agencies. (Fiscal Section.)

j. To audit reservations of funds and allotment requests; to advise on questions pertaining to financial operations, and to verify code classifications. (Fiscal Section.)

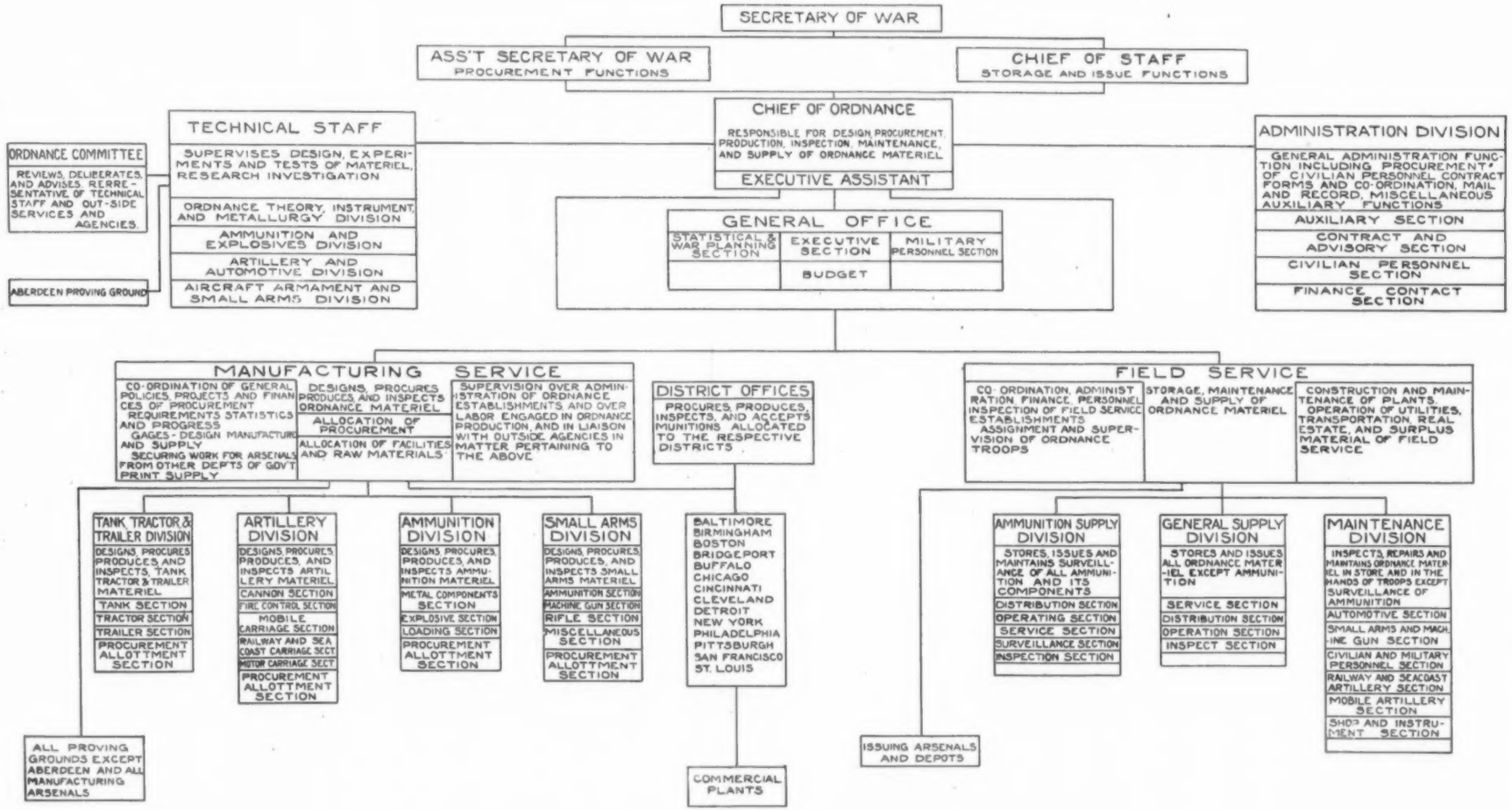
k. To prepare and issue periodic finance statements showing the status of Ordnance funds. (Fiscal Section.)

Statistics and War Plans

l. To exercise general supervision and coordination over the preparation of the war plans of the Ordnance Department. (Statistics and War Plans Section.)

m. To prepare books of Ordnance war requirements schedules, based on the Basic Mobilization Plan and other war plans of the War Department; to furnish these requirements schedules to the Manufacturing Service for preparation of production schedules; to maintain data concerning the approved war reserves; to maintain data furnished by the Field Service as to stocks on hand; to maintain data furnished by the Manufacturing Service concerning production estimates; and to revise periodically requirements and war reserve data. (Statistics and War Plans Section.)

n. To compile and disseminate to the various agencies in the Ordnance Office helpful data in connection


SECRETARY OF WAR
ASS'T SECRETARY OF WAR
PROCUREMENT FUNCTIONS
CHIEF OF STAFF
STORAGE AND ISSUE FUNCTIONS
CHIEF OF ORDNANCE
RESPONSIBLE FOR DESIGN, PROCUREMENT, PRODUCTION, INSPECTION, MAINTENANCE, AND SUPPLY OF ORDNANCE MATERIEL
EXECUTIVE ASSISTANT
ORDNANCE COMMITTEE
REVIEWS, DELIBERATES, AND ADVISES. REPRESENTATIVE OF TECHNICAL STAFF AND OUT-SIDE SERVICES AND AGENCIES.
ABERDEEN PROVING GROUND
TECHNICAL STAFF
SUPERVISES DESIGN, EXPERIMENTS AND TESTS OF MATERIEL, RESEARCH INVESTIGATION
ORDNANCE THEORY, INSTRUMENT, AND METALLURGY DIVISION
AMMUNITION AND EXPLOSIVES DIVISION
ARTILLERY AND AUTOMOTIVE DIVISION
AIRCRAFT ARMAMENT AND SMALL ARMS DIVISION
GENERAL OFFICE
STATISTICAL & WAR PLANNING SECTION
EXECUTIVE SECTION
MILITARY PERSONNEL SECTION
BUDGET
ADMINISTRATION DIVISION
GENERAL ADMINISTRATION FUNCTION INCLUDING PROCUREMENT OF CIVILIAN PERSONNEL CONTRACT FORMS AND CO-ORDINATION, MAIL AND RECORD, MISCELLANEOUS AUXILIARY FUNCTIONS
AUXILIARY SECTION
CONTRACT AND ADVISORY SECTION
CIVILIAN PERSONNEL SECTION
FINANCE CONTACT SECTION
MANUFACTURING SERVICE
CO-ORDINATION OF GENERAL POLICIES, PROJECTS AND FINANCES OF PROCUREMENT
REQUIREMENTS STATISTICS AND PROGRESS
GAGES - DESIGN MANUFACTURE AND SUPPLY
SECURING WORK FOR ARSENALS FROM OTHER DEPTS OF GOVT
PRINT SUPPLY
DESIGNS, PROCURES PRODUCES, AND INSPECTS ORDNANCE MATERIEL
ALLOCATION OF PROCUREMENT
ALLOCATION OF FACILITIES AND RAW MATERIALS
SUPERVISION OVER ADMINISTRATION OF ORDNANCE ESTABLISHMENTS, AND OVER LABOR ENGAGED IN ORDNANCE PRODUCTION, AND IN LIAISON WITH OUTSIDE AGENCIES IN MATTER PERTAINING TO THE ABOVE
DISTRICT OFFICES
PROCURES, PRODUCES, INSPECTS, AND ACCEPTS MUNITIONS ALLOCATED TO THE RESPECTIVE DISTRICTS
FIELD SERVICE
CO-ORDINATION, ADMINISTRATION, FINANCE, PERSONNEL INSPECTION OF FIELD SERVICE ESTABLISHMENTS
ASSIGNMENT AND SUPERVISION OF ORDNANCE TROOPS
STORAGE, MAINTENANCE AND SUPPLY OF ORDNANCE MATERIEL
CONSTRUCTION AND MAINTENANCE OF PLANTS, OPERATION OF UTILITIES, TRANSPORTATION, REAL ESTATE, AND SURPLUS MATERIAL OF FIELD SERVICE
TANK, TRACTOR & TRAILER DIVISION
DESIGNS, PROCURES, PRODUCES, AND INSPECTS TANK TRACTOR & TRAILER MATERIEL
TANK SECTION
TRACTOR SECTION
TRAILER SECTION
PROCUREMENT ALLOTTMENT SECTION
ARTILLERY DIVISION
DESIGNS, PROCURES, PRODUCES, AND INSPECTS ARTILLERY MATERIEL
CANNON SECTION
FIRE CONTROL SECTION
MOBILE CARRIAGE SECTION
RAILWAY AND SEA COAST CARRIAGE SECT
MOTOR CARRIAGE SECT
PROCUREMENT ALLOTTMENT SECTION
AMMUNITION DIVISION
DESIGNS, PROCURES, PRODUCES, AND INSPECTS AMMUNITION MATERIEL
METAL COMPONENTS SECTION
EXPLOSIVE SECTION
LOADING SECTION
PROCUREMENT ALLOTTMENT SECTION
SMALL ARMS DIVISION
DESIGNS, PROCURES, PRODUCES, AND INSPECTS SMALL ARMS MATERIEL
AMMUNITION SECTION
MACHINE GUN SECTION
RIFLE SECTION
MISCELLANEOUS SECTION
PROCUREMENT ALLOTTMENT SECTION
BALTIMORE
BIRMINGHAM
BOSTON
BRIDGEPORT
BUFFALO
CHICAGO
CINCINNATI
CLEVELAND
DETROIT
NEW YORK
PHILADELPHIA
PITTSBURGH
SAN FRANCISCO
ST. LOUIS
ALL PROVING GROUNDS EXCEPT ABERDEEN AND ALL MANUFACTURING ARSENALS
COMMERCIAL PLANTS
ISSUING ARSENALS AND DEPOTS
AMMUNITION SUPPLY DIVISION
STORES, ISSUES AND MAINTAINS SURVEILLANCE OF ALL AMMUNITION AND ITS COMPONENTS
DISTRIBUTION SECTION
OPERATING SECTION
SERVICE SECTION
SURVEILLANCE SECTION
INSPECTION SECTION
GENERAL SUPPLY DIVISION
STORES AND ISSUES ALL ORDNANCE MATERIEL EXCEPT AMMUNITION
SERVICE SECTION
DISTRIBUTION SECTION
OPERATION SECTION
INSPECT SECTION
MAINTENANCE DIVISION
INSPECTS, REPAIRS AND MAINTAINS ORDNANCE MATERIEL IN STORE AND IN THE HANDS OF TROOPS EXCEPT SURVEILLANCE OF AMMUNITION
AUTOMOTIVE SECTION
SMALL ARMS AND MACHINE GUN SECTION
CIVILIAN AND MILITARY PERSONNEL SECTION
RAILWAY AND SEACOAST ARTILLERY SECTION
MOBILE ARTILLERY SECTION
SHOP AND INSTRUMENT SECTION

Organization Chart of the Ordnance Department

with Ordnance Department war plans. (Statistics and War Plans Section.)

o. To compile and furnish all Ordnance statistical data; to follow up, compile, and periodically report the status of Ordnance activities. (Stastics and War Plans Section.)

p. To establish and maintain general liaison with the General Staff, Office of The Assistant Secretary of War, War College, and other outside agencies on matters relating to Ordnance war plans. (Statistics and War Plans Section.)

Military Personnel

q. To procure, assign, classify, and promote military personnel, and to maintain the necessary records in connection therewith. (Military Personnel Section.)

r. To supervise the operation of the Special Service Schools of the Ordnance Department. (Military Personnel Section.)

s. To formulate the necessary training plans and principles, and to supervise the basic training of all military personnel. (Military Personnel Section.)

t. To prepare the data concerning military personnel mobilization required by Office Order No. 569, dated November 6, 1924.

Section III

Administration Division

7. The duties of the Administration Division shall be:

Civilian Personnel

a. To prepare the unit mobilization plans of the Administration Division required by Office Order No. 569, dated November 6, 1924.

b. To maintain the records of employment discharge, and service of all civilian employees of the Ordnance Department, and to prepare estimates for the allotment and statutory rolls. (Civilian Personnel Section.)

c. To administer the Civil Service Regulations, and to prepare plans for the procurement and training of the civilian personnel required in war operations. (Civilian Personnel Section.)

d. To handle all relations with the Appointment Division of the War Department, and with the United States Civil Service Commission. (Civilian Personnel Section.)

Contract and Advisory

e. To assist in obtaining legal advice on all matters affecting the Ordnance Department. (Contract and Advisory Section.)

f. To act as liaison with the Attorney General, the Judge Advocate General, and the Comptroller General with respect to the opinions and decisions of these officers. (Contract and Advisory Section.)

g. To conduct for the Ordnance Department all matters relating to general legislation and actions upon compulsory orders, requisitions or condemnations of private property. (Contract and Advisory Section.)

h. To prepare and prescribe the general forms of contracts to be used by the Ordnance Department; to record and supervise the distribution, and to maintain a permanent file of all contracts made by the Ordnance Department. (Contract and Advisory Section.)

Service

i. To publish all ordnance orders, bulletins, circulars, etc., and to arrange for the printing and issue of all Ordnance publications and miscellaneous matter except drawings. (Service Section.)

j. To be responsible for the office service, including office space, communications, supplies, equipment, and maintenance thereof. (Service Section.)

Mail and Record

k. To receive and distribute all correspondence, and to control and operate the Ordnance Post Office and the mail and record system for the entire office. (Mail and Record Section.)

Section IV

Technical Staff

8. The duties of the Technical Staff shall be:

a. To prepare the unit mobilization plans of the Technical Staff required by Office Order No. 569, dated November 6, 1924.

b. To keep informed of the trend and progress of ordnance development at home and abroad.

c. To recommend to the Chief of Ordnance new and experimental types of ordnance which, when approved by the Chief of Ordnance, will be developed and designed by the Manufacturing Service.

d. To approve for the Chief of Ordnance design and manufacturing specifications and drawings and studies covering types and experimental matériel, and to approve texts of revisions of all matériel in which the functioning will be affected.

e. To consider all requests to make obsolete standard ordnance matériel, and to secure necessary action thereon by higher authority.

f. To have charge of the Aberdeen Proving Ground and all personnel and organizations assigned thereto; to furnish from the Ordnance troops provided for the operation of the Aberdeen Proving Ground trained nuclei required for the mobilization and organization of all Ordnance Proving Ground Companies authorized for proving grounds of the Manufacturing Service.

g. To conduct, or approve, programs of all trials of pilot ordnance matériel (except shop tests, routine and minor firing tests at arsenals, and preliminary road tests); and, whenever possible, to attend important trials of ordnance in other services in this country and abroad.

h. To investigate all failures or defects of ordnance matériel in service or storage, and recommend the necessary remedial action.

i. To have custody of the Ordnance Office Model Room.

j. To develop plans for wider publication and distribution of ordnance engineering data, and to encourage discussion and development of its theoretical principles.

k. To maintain and administer the technical library of the Ordnance Office, and to authorize the purchase of all books and subscriptions for periodicals, magazines, etc., for the Ordnance Office, and to approve all similar requests received from establishments in the field.

l. To act as liaison on technical matters with all Departments of the Government, all engineering societies and, through the Military Intelligence Division

of the General Staff, with all foreign countries in requesting, receiving, filing and distributing throughout the Ordnance Department all data or information of technical interest.

m. To arrange for the assignment to the Ordnance Committee of qualified officers of the Line of the Army and such civilian engineers as found advisable.

n. To conduct research work in ordnance theory and ballistics.

o. To approve all programs and estimates for experimental and research work initiated for the purpose of improving ordnance matériel.

p. To standardize and approve all specifications prepared by or affecting the Ordnance Department.

Ordnance Committee

9. The Ordnance Committee is advisory to the Chief of the Technical Staff. Its membership shall be designated by the Chief of Ordnance. It shall be the duty of the Ordnance Committee to consider and recommend action upon all matters affecting matériel designed for or intended to be issued to the Service coming within the jurisdiction of the Technical Staff, and upon such other matters as may be referred to it by the Chief of the Technical Staff.

Section V

Manufacturing Service.

10. The duties of the Manufacturing Service shall be:

a. To design, develop, procure, produce and inspect all ordnance matériel, gages, and other ordnance and ordnance stores, and to perform all duties incident thereto not otherwise specifically assigned by the Chief of Ordnance.

b. To prepare the unit mobilization plans of the Manufacturing Service required by Office Order No. 569, dated November 6, 1924.

c. To prepare war production schedules to cover all items found on requirements schedules furnished by the General Office, and to initiate and carry out all work necessary to make the war production schedules effective; to review periodically all war production schedules; to analyze reports from the Ordnance District Offices and manufacturing arsenals as to production possibilities, and to incorporate these data in the periodic review of the war production schedules, and to furnish copies of the production schedules and of the periodic reviews to the General Office.

d. To have general charge of the Ordnance Districts created for the purpose of procurement in time of war and to furnish to them all information necessary for the prosecution of industrial war plans.

e. To have general charge of the manufacturing arsenals and to furnish them information necessary for the prosecution of industrial war plans.

f. To set up detailed manufacturing schedules and to initiate the work thereunder necessary to meet the requirements.

g. To prepare estimates of the cost of all manufacturing and experimental programs.

h. To submit for the approval of the Technical Staff design and manufacturing specifications, and drawings and studies covering type and experimental matériel; to submit to the Technical Staff for approval texts of revisions of all matériel in which functioning will be affected; and to approve all drawings and specifications not requiring action by the Technical Staff.

i. To initiate, conduct and follow-up experimental and development work required for the development of new types or the improvement of existing types.

j. To establish and maintain Ordnance standard practice sheets covering the standards for ordnance design.

k. To assist manufacturers to become acquainted with ordnance matériel and manufacturing problems connected therewith.

l. To maintain full information with respect to available sources of supply for all matériel, including raw material and with respect to the manufacturing facilities in the United States capable of producing ordnance matériel.

m. To have charge of the making of blue prints, brown prints, photostats, etc.

n. To provide for the storage and distribution of experimental matériel.

o. To initiate and prepare specifications covering all ordnance matériel; to submit these specifications, after approval by the Technical Staff, to the proper War Department agency for action, and to follow-up such specifications until finally approved; to maintain standard files of all Army, Navy, and Federal specifications; to maintain contact with, and furnish a representative on, the Federal Specifications Board.

p. To prepare handbooks and pamphlets covering descriptions and instructions for the use of ordnance matériel.

q. To take charge of all matters concerning the fixed-nitrogen interests of the Department and the operation and future disposition of fixed-nitrogen plants.

r. To have charge of all proving grounds (except the Aberdeen Proving Ground) and all personnel and organizations assigned thereto.

s. To prepare price lists of all ordnance matériel.

t. To handle all interbureau procurement instructions.

u. To establish general rules and regulations for the conduct of business at Ordnance establishments, and to handle all questions arising between such establishments and other branches of the War Department or other government departments.

v. To obtain from other Federal Departments work for the arsenals suited to their facilities when necessary to provide continuous employment for the nuclei of their organizations.

w. To handle all questions concerning hours of labor, leave, determination of rates of pay, housing, transportation and general conditions affecting the safety and welfare of employees.

Section VI

Field Service

11. The duties of the Field Service shall be:

a. To supply all ordnance matériel to troops; to inspect, repair, alter and maintain all ordnance matériel in the hands of troops and in storage; and to control and operate the personnel, organizations, permanent establishments and field facilities assigned to these duties.

b. To prepare the unit mobilization plans of the Field Service required by Office Order No. 569, dated November 6, 1924.

c. To administer and train all Ordnance troops (except Proving Ground, and Training Companies).

d. To prepare training regulations for Ordnance

Companies (except Proving Ground, and Training Companies).

e. To bring to the attention of the Manufacturing Service and the Technical Staff any improvements or changes in ordnance matériel which may be suggested as necessary or desirable.

f. To receive and act upon all requisitions for standard articles of ordnance matériel.

g. To make timely requisitions to maintain stocks in conformity with Requirements Schedules; to establish proper maximum and minimum limits so as to insure adequate stocks for reserve and issue purposes in accordance with approved policies.

h. To handle all condemnations, sales or other authorized dispositions of ordnance and ordnance stores, except those of components to be used in manufacture.

i. To cooperate with the Manufacturing Service and the using services in the uniform packing and marking of ordnance stores.

j. To store all ordnance matériel procured for issue; to store component matériel when requested by the Chief of Manufacture and to arrange for the shipments incident thereto.

k. To have charge of all Ordnance establishments used exclusively for storage and maintenance purposes.

l. To prepare estimates for the maintenance of matériel in the hands of troops and in storage; to prepare estimates for all expenses in connection with the receiving, storage and issue of ordnance stores; and to allot funds for these activities.

m. To maintain a running inventory of all ordnance stores, including component stores for the storage of which it is responsible.

n. To give timely advice to the Manufacturing Service regarding stores required for Field Service account.

Section VII

12. Each group shall have charge of the establishments thereunder assigned to it by this Section, except as otherwise provided in this order. This assignment of Ordnance establishments shall be as follows:

General Office

Special Service Schools

The Ordnance School.
The Ordnance Specialists School.

Technical Staff

Aberdeen Proving Ground.

Manufacturing Service

Frankford Arsenal, Picatinny Arsenal, Rock Island Arsenal, Springfield Armory, Watertown Arsenal, Watervliet Arsenal, U. S. Nitrate Plant No. 1, U. S. Nitrate Plant No. 2, all Proving Grounds (except Aberdeen).

Field Service

Augusta Arsenal, Benicia Arsenal, Hawaiian Ordnance Depot, Aberdeen Ordnance Reserve Depot, Erie Ordnance Reserve Depot, Charleston Ordnance Reserve Depot, Curtis Bay Ordnance Reserve Depot, Old Hickory Ordnance Reserve Depot, Philippine Ordnance Depot, Panama Ordnance Depot, San Antonio Arsenal, Delaware Ordnance Reserve Depot, Savannah Ordnance Reserve Depot, Pig Point Ordnance Reserve Depot, Raritan Arsenal, Wingate Ordnance Reserve Depot, Ogden Ordnance Reserve Depot.

C. C. WILLIAMS,
Major General, Chief of Ordnance.

OFFICIAL:
C. T. HARRIS, JR.,
Major, Ord. Dept.

Make This Coupon Productive: Bring In a New Member

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THE SECRETARY
ARMY ORDNANCE ASSOCIATION
Mills Building, Washington, D. C.

I desire to enroll as a Member of the ARMY ORDNANCE ASSOCIATION, and enclose check for $5.00 to cover annual dues for one year from date, of which $3.00 is for a year's subscription to ARMY ORDNANCE—the official Journal of the Association.

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City and State

*Business Connection*_____

Make check payable to "Army Ordnance Association"

Recent Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

A NUMBER of patents have been issued recently which are of more or less interest to those making a special study of the Ordnance arts.

Ammunition

The following patents relate more specifically to Ammunition:

Letters Patent No. 1,513,411 have been granted to Alton S. Miller for the art of controlling time powder trains. The art consists in so designing the train that it will evolve gases at a constant quantity rate, discharging the gases through a fixed orifice having an area such that it will exert a back pressure on the gases throughout all changes of atmospheric pressure. This patent appears to cover an idea heretofore disclosed in the art.

A patent on a fuze for projectiles has been granted to Max W. Fischer, the patent being No. 1,515,668. In this fuze, a plunger is provided carrying a striker normally unarmed by being retracted into the plunger and held in such retracted position by a series of balls. A plunger adapted to set back on discharge of a projectile normally holds the balls in position but, when the plunger sets back, the balls are thrown into the space occupied by the plunger by centrifugal force, allowing the striker to advance to armed position, where it is held by another ball normally housed in a recess in the main plunger.

Patent No. 1,515,705 has been granted to Frank Short, formerly employed at the Aberdeen Proving Ground, for a bomb. This patent covers a tail piece for bombs and a method of constructing the same.

Samuel Wiley, of Picatinny Arsenal, has been granted patent No. 1,517,810 for a fuze. This patent covers a mechanism normally held unarmed by a counterweight, which counterweight is held in position on the fuze by a combustible material and is free after the combustion of the material to release the fuze upon impact of the projectile.

Artillery

PATENTS relating to Artillery include:

Paul Kaminski has been granted patent No. 1,512,-103, for remote control system. This patent covers an electrical signalling system for transmitting the angle of inclination to a battery of guns.

R. S. Hoar, formerly an officer in the Coast Artillery Corps, has been granted a patent, No. 1,512,601, for means for and method of determining true north, latitude, and approximate sidereal time, or any of them. This device is an attachment for a telescope and was tried out by the Coast Artillery with considerable success.

R. C. Morgan and John F. Pelley, assignors to the Bethlehem Steel Company, have been granted patent No. 1,514,166 for a method of assembling tubes and liners in gun manufacture. The method consists essentially in shrinking a tube upon a liner, the liner being positively prevented from contracting longitudinally.

R. C. Morgan and John F. Pelly, assignors to Bethlehem Steel Company, have also been granted patent No. 1,514,167 for a method for assembling tubes and liners in gun manufacture. The invention consists specifically in shrinking the tube on a liner, a section of which liner has been expanded, preferably that section adjacent to the thick end of the tube.

R. C. Morgan and John F. Pelly, assignors to Bethlehem Steel Company, have been granted patent No. 1,514,-168 for an apparatus for assembling tubes and liners in gun construction. This patent covers an apparatus for holding a liner against movement in a muzzle end direction while the tube is being shrunk thereon.

R. C. Morgan and J. F. Pelly, assignors to Behtlehem Steel Company, have been granted patent No. 1,514,169 for an apparatus for assembling tubes and liners in gun construction. The patent covers an apparatus for stretching the liner and holding it against change of length and heating, and expanding a section thereof while the tube is being shrunk thereon.

A. Barr and W. Stroud have been granted patent No. 1,514,948 for a stereoscopic range finder. The invention consists in the provision in each field of view of a series of marks or lines, distributed over the field, which marks appear to be set at the same perspective depth when viewed stereoscopically.

E. Schneider has been granted patent No. 1,517,758 for an apparatus for loading and ramming projectiles in guns. The main feature and novelty in this rammer consists in its acting with a rectilinear movement followed by a swinging movement.

A. Barr and W. Stroud have been granted patent No. 1,519,015, for an antiaircraft fire control apparatus. The claims in this case appear to be drawn to a series of devices for computing the various data necessary in directing a gun at a moving target such as an airplane.

The Union Malleable Iron Co.

EAST MOLINE, ILL., U. S. A.

The Only Manufacturers of the ORIGINAL

Head PATENT GEAR LINK DRIVE AND CONVEYOR Chain

AGRICULTURAL IMPLEMENT ...AND RAILWAY CASTINGS...

WRITE FOR CATALOG

The Rock Island Arsenal

In a Rich and Growing Community

SERVED WELL

With Power, Light, Gas and Transportation

As neighbor and co-worker in "Effecting Industrial Preparedness for War," it is especially fitting that this Company say a friendly word for the Rock Island Arsenal.

Located as it is on an island in the Mississippi River, the workmen at the Arsenal must find homes in Iowa or Illinois several miles from their places of work. The Rock Island Arsenal, therefore, depends upon the Tri-City Railway Companies of Iowa and Illinois, subsidiaries of this Company, to provide transportation for workmen, and the furnishing of this service has always met every demand including that of the war period when there were approximately 20,000 employees at the Rock Island Arsenal.

This Company was ready with the surplus of power, gas, light, and street railway facilities required during the emergency of the World War. In 1918, the company's power house, directly across Sylvan Water from the main Arsenal shops and adjoining the government's property, had 61,000 horsepower available for the community and the Arsenal. Since that time the power available from this plant has been increased to 100,000 horsepower and a new plant is under construction on the Iowa shore to develop ultimately nearly 200,000 horsepower in addition.

The hydro-electric power plant, which is part of the complete equipment belonging to the Rock Island Arsenal is operated more economically because its surplus power is absorbed by the Peoples Power Company of Rock Island, Moline, and East Moline, Illinois, and the Peoples Light Company, of Davenport, Iowa, also subsidiaries. The power available from this hydro-electric plant has a seasonable reduction due to high water, low water, and ice, and the power requirements of the Arsenal also vary with the amount of work being done. When more power is needed than can be furnished by its own plant the Arsenal secures the extra power from our steam power plant at economical wholesale rates.

Good service at low rates in the essentials of power, light, gas and transportation is one of the features which makes this a most suitable industrial center for the maintenance and development of our greatest Arsenal.

The United Light and Power Company

Rock Island, Moline and East Moline, Illinois—Davenport, Iowa